1.0

DEFENSE ENVIRONMENTAL
RESTORATION PROGRAM

FINAL RECORD OF DECISION

UMATILLA DEPOT ACTIVITY
AMMUNITION DEMOLITION ACTIVITY AREA
OPERABLE UNIT

June 10, 1994

Signed 9-30-94

In accordance with Army Regulation 200-2, this document is intended by the Army to comply with the National Environmental Policy Act of 1969 (NEPA).

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List of Figures and Tables

Acronyms and Abbreviations

ADA	Ammunition Demolition Activity Area
ARARs	Applicable or Relevant and Appropriate Requirements
BB	Below Background
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
cy	Cubic Yards
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenylethane
DDT	Dichlorodiphenyltrichloroethane
2,4-DNT	2,4-Dinitrotoluene
2,6-DNT	2,6-Dinitrotoluene
DoD	Department of Defense
EA	Ecological Assessment
EPA	U.S. Environmental Protection Agency
EPIC	Environmental Photographic Interpretation Center
FFA	Federal Facility Agreement
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (High Melting Explosive)
HRS	Hazard Ranking System
HQ	Hazard Quotient
IRIS	Integrated Risk Information System
lb	Pound
LDR	Land Disposal Restrictions
MCL	Maximum Contaminant Level

NA	Not Analyzed
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDB	Not Detected Above Background
NEPA	National Environmental Policy Act
NOAELs	No Observed Adverse Effect Levels
NPL	National Priorities List
NSA	No Standard Available
O&M	Operations and Maintenance
OAR	Oregon Administrative Rules
ODEQ	Oregon Department of Environmental Quality
ppm	Parts Per Million (equivalent to µg/g and mg/kg)
RA	Human Health Baseline Risk Assessment
RAB	Restoration Advisory Board
RAC	Remedial Action Criteria
RCRA	Resource Conservation and Recovery Act
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine (Royal Demolition Explosive)
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
TBC	To Be Considered
TCLP	Toxicity Characteristic Leaching Procedure
TNB	1,3,5-Trinitrobenzene
TNT	2,4,6-Trinitrotoluene
TRC	Technical Review Committee

TSDF	Treatment, Storage, and Disposal Facility
UCL	Upper Confidence Limit
UMDA	U.S. Army Depot Activity at Umatilla
USAEC	U.S. Army Environmental Center (formerly USATHAMA)
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
UXO	Unexploded Ordnance

1.0 Declaration of the Record of Decision

Site Name and Location

U.S. Army Depot Activity, Umatilla
Ammunition Demolition Activity Area Operable Unit
Hermiston, Oregon 97838-9544

Statement of Basis and Purpose

This decision document presents the selected remedial action for the Ammunition Demolition Activity Area (ADA) Operable Unit at the U.S. Army Depot Activity, Umatilla (UMDA), at Hermiston, Oregon, which has been selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The decision is based on the administrative record for this site. Documents supporting the selection of the remedy are identified in Attachment A to this Record of Decision (ROD).

The remedy was selected by the U.S. Army and the U.S. Environmental Protection Agency (EPA). The State of Oregon concurs with the selected remedy.

Assessment of the Site

Actual or threatened releases of hazardous substances from the site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of the Selected Remedy

The selected remedy for the contamination at the ADA includes the implementation of actions to (1) clean up chemically contaminated soils; (2) remove unexploded ordnance (UXO) items from the ground surface; (3) detect and quantify UXO below the ground surface; and (4) conduct retrieval and treatment of buried UXO to a depth that will allow for the selected land use under Base Realignment and Closure.

The specific steps involved in the cleanup of contaminated soils at the ADA will include:

- Excavation of approximately 14,000 cubic yards of contaminated soil at five separate sites at the ADA (Site Numbers 15, 17, 19, 31, and 32). UXO items would be removed from these sites during excavation as necessary to permit safe excavation and access.
- Treatment of contaminated soils by a mobile solidification/stabilization system.
- Disposal of the treated soil from the solidification/stabilization system into the on-site UMDA landfill.
- Restoration of excavated areas with clean backfill and vegetation.

A phased approach will be taken to quantify and reduce risks to the environment and human health and safety posed by the presence of UXO. Phase I of this approach will consist of the following actions:

- Conducting a metallic object survey over the entire ADA to obtain a better estimate of how much metallic debris would have to be removed to clear the ADA of possible ordnance.
- Conducting (concurrent with metallic object survey) a "visual sweep" over the ADA to locate and remove objects identifiable as ordnance .

Phase II will consist of the removal of buried UXO that is consistent with the future use selected for the ADA. Prior to the initiation of Phase II, the Army, EPA, and the Oregon Department of Environmental Quality (ODEQ) will meet to review (1) refined cost estimates for clearance of buried UXOs in the ADA and (2) the selected land use decided under BRAC. The Army, EPA, and ODEQ will make a final decision on the depth of UXO clearance required to support the selected land use. In the event that the Army, EPA, and ODEQ cannot reach an agreement, the decision will be subject to the provisions of the Umatilla Federal Facilities Agreement (FFA), including dispute resolution. Providing an agreement is reached, the initiation of Phase II is planned within 15 months after a final land use decision has been made.

Following the actions described above to clean up contaminated soil and detect and remove UXO, institutional controls will be applied to the ADA to permanently control access to, and use of, the ADA consistent with the final use selected.

Statutory Determinations

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

The cleanup levels, listed herein, for chemically contaminated soil are protective to allow for possible future industrial use. However, the continued presence of UXO will require that institutional controls be implemented at the ADA to restrict access and future use. In order to ensure that this cleanup remedy continues to be protective, a site review will be conducted every five years. This review will include verifying that institutional controls remain in place and that land use of the ADA has not changed.

Lead and Support Agency Acceptance of the Record of Decision
U.S. Army Depot Activity Umatilla
Ammunition Demolition Activity Area Operable Unit

Signature sheet for the foregoing Record of Decision for the Ammunition Demolition Activity Area Operable Unit final action at the U.S. Army Depot Activity at Umatilla between the U.S. Army and the United States Environmental Protection Agency, with concurrence by the State of Oregon Department of Environmental Quality.

Lewis D. Walker
Lewis D. Walker
Deputy Assistant Secretary of the Army
(Environment, Safety, and Occupational Health)

9/30/94
Date

Lead and Support Agency Acceptance of the Record of Decision
U.S. Army Depot Activity Umatilla
Ammunition Demolition Activity Area Operable Unit (Cont'd)

Signature sheet for the foregoing Record of Decision for the Ammunition Demolition Activity Area Operable Unit final action at the U.S. Army Depot Activity at Umatilla between the U.S. Army and the United States Environmental Protection Agency, with concurrence by the State of Oregon Department of Environmental Quality.

Moses Whitehurst Jr.
Lieutenant Colonel Moses Whitehurst, Jr.
Commander, U.S. Army Depot Activity, Umatilla

28 July 94
Date

Lead and Support Agency Acceptance of the Record of Decision
U.S. Army Depot Activity Umatilla
Ammunition Demolition Activity Area Operable Unit (Cont'd)

Signature sheet for the foregoing Record of Decision for the Ammunition Demolition Activity Area Operable Unit final action at the U.S. Army Depot Activity at Umatilla between the U.S. Army and the United States Environmental Protection Agency, with concurrence by the State of Oregon Department of Environmental Quality.

Mark Daugherty
Mark Daugherty
BRAC Environmental Coordinator
U.S. Army Depot Activity, Umatilla

28 July 94
Date

Signature sheet for the foregoing Record of Decision for the Ammunition Demolition Activity Area Operable Unit final action at the U.S. Army Depot Activity at Umatilla between the U.S. Army and the United States Environmental Protection Agency, with concurrence by the State of Oregon Department of Environmental Quality.

Chuck Clarke
Regional Administrator, Region X
U.S. Environmental Protection Agency

7/19/94
Date

Lead and Support Agency Acceptance of the Record of Decision
U.S. Army Depot Activity Umatilla
Ammunition Demolition Activity Area Operable Unit (Cont'd)

Signature sheet for the foregoing Record of Decision for the Ammunition Demolition Activity Area Operable Unit final action at the U.S. Army Depot Activity at Umatilla between the U.S. Army and the United States Environmental Protection Agency, with concurrence by the State of Oregon Department of Environmental Quality.

Mark Daugherty
Mark Daugherty
BRAC Environmental Coordinator
U.S. Army Depot Activity, Umatilla

28 July 94
Date

Lead and Support Agency Acceptance of the Record of Decision
U.S. Army Depot Activity Umatilla
Ammunition Demolition Activity Area Operable Unit (Cont'd)

Signature sheet for the foregoing Record of Decision for the Ammunition Demolition Activity Area Operable Unit final action at the U.S. Army Depot Activity at Umatilla between the U.S. Army and the United States Environmental Protection Agency, with concurrence by the State of Oregon Department of Environmental Quality.

Chuck Clarke
Chuck Clarke
Regional Administrator, Region X
U.S. Environmental Protection Agency

7/16/94
Date

Signature sheet for the foregoing Record of Decision for the Ammunition Demolition Activity Area Operable Unit final action at the U.S. Army Depot Activity at Umatilla between the U.S. Army and the United States Environmental Protection Agency, with concurrence by the State of Oregon Department of Environmental Quality.

Fred Hansen
Director, Oregon Department of Environmental Quality

JUL 26 1994
Date

Note: The State of Oregon's Letter of Concurrence is appended to this Record of Decision.

2.0 Decision Summary

This Decision Summary provides an overview of the problems posed by the conditions at the UMDA ADA, the remedial alternatives, and the analysis of those options. It explains the rationale for the remedy selection and describes how the selected remedy satisfies statutory requirements.

2.1 Site Name, Location, and Description

UMDA is located in northeastern Oregon in Morrow and Umatilla Counties, approximately 5 miles west of Hermiston, Oregon, as shown in Figure 1. The installation covers about 19,700 acres of land. The ADA is located in the northwestern portion of UMDA. This approximately 1,750-acre area contains 20 individual sites that have been identified as areas of historical or current Army activities. The locations of these sites are presented in Figure 2.

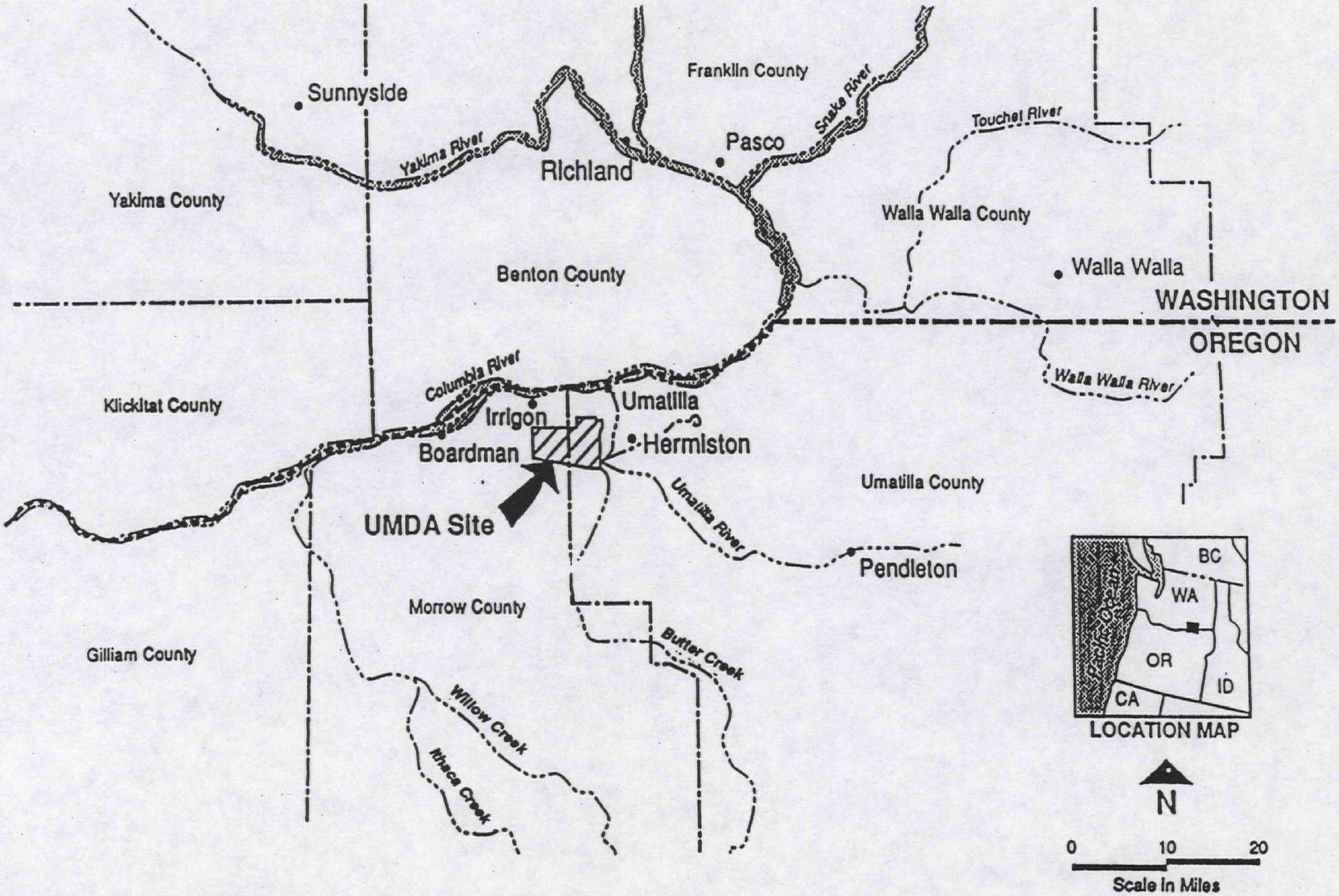
The region surrounding UMDA is primarily used for irrigated agriculture. The population centers closest to UMDA are Hermiston (population 10,075), approximately 5 miles east; Umatilla (population 3,032), approximately 3 miles northeast; and Irrigon (population 820), 2 miles northwest. The total populations of Umatilla and Morrow Countries are approximately 59,000 and 7,650, respectively.

Northeastern Oregon, the setting for UMDA (and the ADA), is characterized by a semi-arid, cold desert climate, an average annual precipitation of 8 to 9 inches, and a potential evapo-transpiration rate of 32 inches. The installation is located on a regional plateau of low relief that consists of relatively permeable glaciofluvial sand and gravel overlying Columbia River Basalt.

Ground water at UMDA occurs primarily in two settings: in an unconfined aquifer within the overlying deposits and weathered basalts, and in a vertical sequence of semi-confined and confined aquifers within the basalt. Regional flow gradients in the uppermost unconfined aquifer are influenced by irrigation, pumping, and leakage from irrigation canals. Ground water flow directions in this aquifer reverse seasonally in response to off-post pumping and recharge activities. During the summer and early fall, flow is toward the east and south as irrigation activities peak. During the winter and early spring, when irrigation activities are at a minimum, ground water flow is to the north and west. Approximately 1,470 wells have been identified within a 4-mile radius of UMDA, the majority of which are used for domestic and irrigation water. Three municipal water systems (Hermiston, Umatilla, and Irrigon) draw from ground water within a 4-mile radius of UMDA.

The Columbia River flows from east to west approximately 3 miles to the north of the UMDA boundary, and the Umatilla River flows from south to north approximately 1 to 2 miles to the east. The Columbia River is a major source of potable and irrigation water, and is also used for recreation, fishing, and the generation of hydroelectric power. The principal use of the Umatilla River is irrigation. No natural streams occur within UMDA; the facility is characterized by areas of closed drainage.

The topography of the ADA is relatively flat with occasional gently rolling hills or ridges. Elevations are in the range of approximately 460 to 580 feet above mean sea level. Soils at the ADA sites typically consist of fine- to medium-grained sand. Vegetation is relatively sparse, consistent with the UMDA installation in general. Depths to ground water at the ADA sites are in the range of approximately 60 to 100 feet below the ground surface.



Source: Arthur D. Little, Inc., 1993, Fig. 1

Figure 1
Facility Location Map
Umatilla Depot Activity

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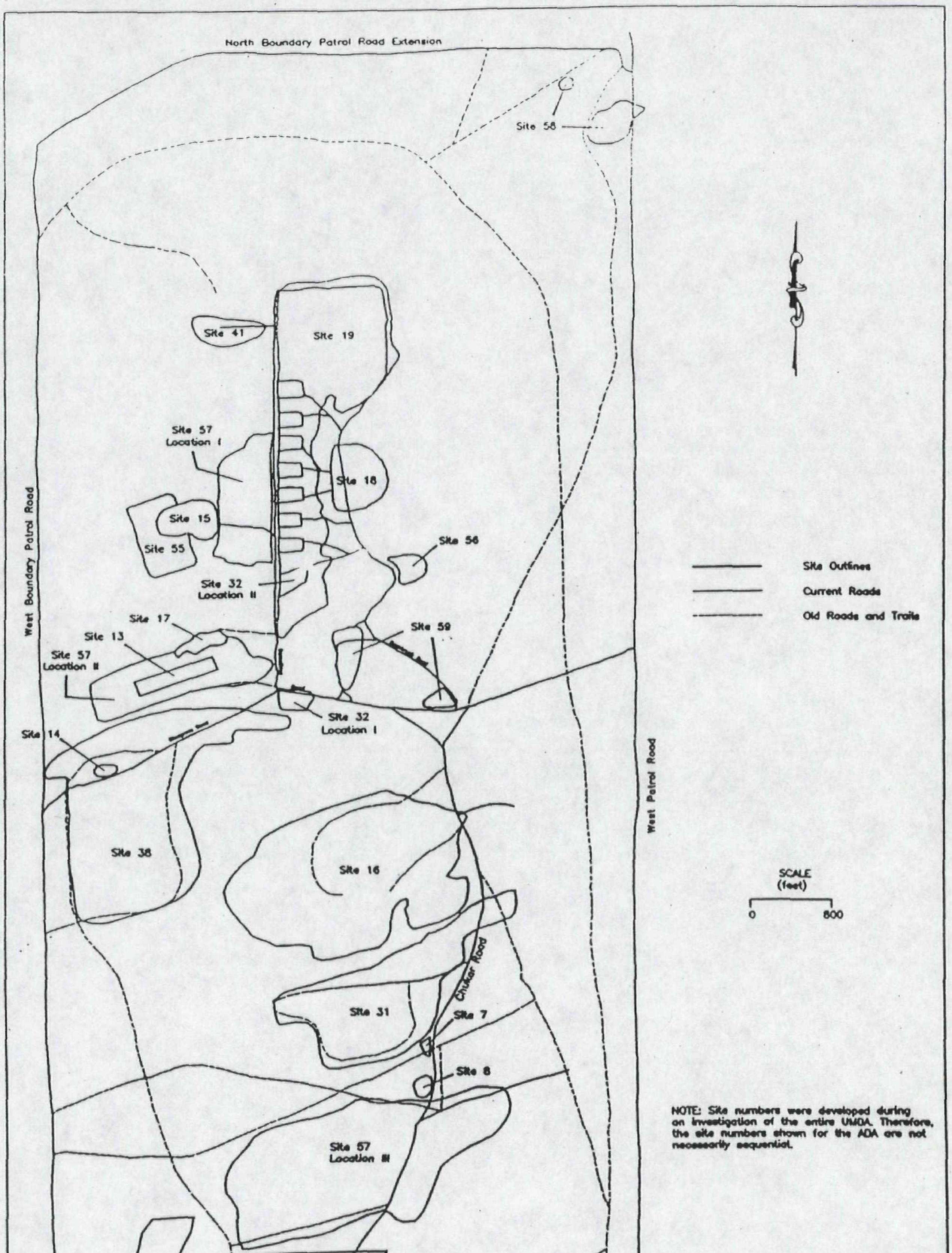

Location of ADA Sites

Figure 2

jm.d/rod.67062-62.8/94

2.2 Site History and Enforcement Activities

UMDA was established as an Army ordnance depot in 1941 for the purpose of storing and handling munitions. Access is currently restricted to installation personnel and authorized contractors and visitors. UMDA is included in the Department of Defense (DoD) Base Realignment and Closure (BRAC) program which requires that the conventional ordnance storage mission be transferred to another installation. In view of the DoD's initiatives to promote early reuse of closing installations, property transfer of UMDA (and the ADA) could occur in the future.

Since 1945, the ADA has been used by the Army to dispose of ordnance and other solid wastes by burning, detonation, dumping, or burial. Activities were conducted at a number of locations throughout the ADA. Twenty sites have been identified as actual or possible locations of Army activities at the ADA. Specific characteristics of these 20 sites at the ADA are presented in Table 1.

In addition to possible chemical contamination at these 20 sites, ADA activities also resulted in the presence of unknown quantities of UXO at unknown locations across the entire ADA.

An initial installation-wide assessment was performed in 1978 and 1979 to evaluate environmental quality at UMDA with regard to the past use, storage, treatment, and disposal of toxic and hazardous materials. Based on aerial imagery analysis provided by EPA's Environmental Photographic Interpretation Center (EPIC) as part of the assessment, the UMDA was characterized as containing potentially hazardous sites. In 1981, Battelle conducted an Environmental Contamination Survey and Assessment at UMDA. This survey and assessment included the sampling and analysis of soils and ground water across UMDA (including the ADA). Also in 1981, the U.S. Army Environmental Hygiene Agency conducted a Hazardous Waste Management Study at the ADA in which they sampled and analyzed soils at a limited number of locations at the ADA. An additional assessment was performed in 1988 by Weston in which soil and ground water sampling and analysis were performed at a number of the ADA sites.

In 1984, an evaluation of the Explosives Washout Lagoons (a contaminated area located within UMDA but outside of the ADA) was performed using EPA's Hazard Ranking System (HRS). Based on the results of this evaluation, the lagoons were proposed for inclusion on the National Priorities List (NPL) on October 15, 1984. They were formally listed on the NPL on July 22, 1987 based on the HRS results as well as the results of the installation Resource Conservation and Recovery Act (RCRA) Facility Assessment.

On October 31, 1989, a Federal Facility Agreement (FFA) was executed by UMDA, the Army, EPA Region X, and the Oregon Department of Environmental Quality (ODEQ). The FFA identifies the Army as the lead agency for initiating response actions at UMDA. One of the purposes of the FFA was to establish a framework for developing and implementing appropriate response actions at UMDA in accordance with CERCLA, the NCP, and Superfund guidance and policy. A remedial investigation (RI) and feasibility study (FS) of the entire UMDA installation, including the ADA, was initiated in 1990 to determine the nature and extent of contamination and to identify alternatives available to clean up the facility.

Table 1: ADA Site Names and General Descriptions

Site Number/Name	Description
7 Aniline Pit	Small fenced area reportedly used to dispose of aniline (a missile fuel component)
8 Acid Pit	Small pit reportedly used to dispose of red fuming nitric acid
13 Smoke Canister Disposal Area	Long, narrow mound in which debris from smoke canister burning operations was found
14 Flare and Fuse Disposal Area	Mound of soil containing debris from flare and fuse burning operations
15 TNT Sludge Burial and Burn Area	Sludges from Explosives Washout Plant and/or other wastes reportedly dumped at this site
16 Open Detonation Pits	Rows of pits in which conventional munitions have been, and are currently being detonated
17 Aboveground Open Detonation Area	Area used for the detonation of decontaminated rockets and land mines
18 Dunnage Pits	Several historical pits reportedly used to dispose of and burn dunnage, liquid wastes, and sludges
19 Open Burning Trenches/Pads	Row of trenches and a burn field area reportedly used to burn explosives sludges and other wastes
21 Missile Fuel Storage Areas	Sheds used to store missile fuel components
31 Pesticide Pits	Several pits reportedly used to burn or dispose of pesticide solutions
32 Open Burning Trays	Two areas currently in use to conduct permitted open burning operations
38 Pit Field Area	Several rows of pits that were reportedly used to explode and dispose of old or faulty ordnance
41 Chemical Agent Decontamination Solution Burial Area	Trench and pit suspected to have been used as a burial area for chemical agent decontamination solutions
55 Trench/Burn Field	Several rows of apparent burn trenches – specific operations that occurred there are unknown
56 Munitions Crate Burn Area	Circular area reportedly used to burn empty wooden crates
57 Former Pit Area Locations	Three areas containing pits – specific operations that occurred there are unknown
58 Borrow/Burn/Disposal Area	Area showing signs that burning operations may have been conducted there
59 Chemical Agent Decontamination Solution Disposal Areas	Pits suspected to have been used as a disposal area for chemical agent decontamination solutions
60 Active Firing Range	18-acre site currently in use by the National Guard as a rifle, machine gun, and grenade firing range

An extensive sampling and analysis program was initiated at the ADA as part of the RI conducted by Dames & Moore. This investigation included the assessment of soil contamination at each of the 20 ADA sites as well as an overall assessment of potential ground water contamination beneath the ADA. In addition, this investigation included the evaluation and summary of the prior investigations conducted at the ADA. Soil and ground water characterization data developed during these investigations were used to develop a human health baseline risk assessment, completed in 1992. Based on information developed in the RI (including the Risk Assessment), a feasibility study of cleanup actions at the ADA was completed in 1993.

A list of documents that outline the results of the site investigations and assessments of cleanup actions for the ADA is provided as Attachment A to this ROD.

2.3 Highlights of Community Participation

In 1988, UMDA assembled a Technical Review Committee (TRC) composed of elected and appointed officials and other interested citizens from the surrounding communities. In December 1993, the TRC was converted to a Restoration Advisory Board (RAB). Quarterly meetings provide an opportunity for UMDA to brief the RAB on installation environmental restoration projects and to solicit input from the RAB. Three RAB meetings were held during preparation of the supplemental investigation and feasibility study for the ADA Operable Unit. In those meetings, the RAB was informed as to the scope and methodology of the investigation and cleanup.

The Feasibility Study and Proposed Plan for the ADA Operable Unit were released to the public on February 15, 1994. The public comment period started on that date and ended on March 17, 1994. Documents relative to the RI and the FS were made available to the public at the following information repository locations: UMDA Building 32, Hermiston, Oregon; the Hermiston Public Library, Hermiston, Oregon; and the EPA offices in Portland, Oregon. The notice of availability of the Proposed Plan was published in the *Hermiston Herald*, the *Tri-City Herald*, and the *East Oregonian* in February 1994.

A public meeting was held at Armand Larive Junior High School, Hermiston, Oregon, on March 2, 1994, to inform the public of the preferred cleanup alternative and to seek public comments. At this meeting, representatives from UMDA, the U.S. Army Environmental Center (USAEC), EPA, ODEQ, and Arthur D. Little, Inc. (an environmental consultant to USAEC) answered questions about the site and remedial alternatives under consideration. A response to comments received during this period is included in the Responsiveness Summary in Section 3.0 of this ROD.

2.4 Scope and Role of Response Action

Response actions are discrete actions that constitute incremental steps toward a final overall remedy. They can be actions that completely address a geographic portion of a site or a specific problem, or can be one of many actions that will be taken at the site. At UMDA, response actions are directed at eight areas identified as operable units based on the results of the RI. These operable units include:

- Inactive Landfills
- Active Landfill
- Explosives Washout Lagoon Soils
- Explosives Washout Lagoon Ground Water

- Explosives Washout Lagoon Plant
- Deactivation Furnace (and surrounding soils)
- Ammunition Demolition Activity Area (ADA)
- Miscellaneous Sites

The ADA Operable Unit, a 1,750-acre area located in the northwest corner of UMDA, contains 20 sites with varying degrees of possible contamination. In addition, UXO are potentially present across the entire ADA (UXO are not limited to the 20 defined sites). The threats described in this ROD are those associated with contaminated soil at these sites and the presence of unknown quantities of UXO at unknown locations throughout the ADA. The cleanup strategy presented in this ROD includes an action for soil in addition to a specified degree of removal of UXO from the ADA.

2.5 Site Characteristics

The sources of contamination at the ADA are activities associated with the disposal of ordnance and other solid wastes by burning, detonation, dumping, or burial. (Refer to Table 1 for a general description of each of the 20 ADA sites.) The types of contamination include:

- Explosives (contained in ordnance or other wastes disposed of)
- Metals (contained in ordnance and munition casings being burned, detonated, or disposed of)
- Pesticides (through application or disposal)
- UXO and related metallic debris

2.5.1 Results of Soil Investigations

Several soil investigations have been conducted at the ADA since 1981. Samples collected from surface soils and from soil borings have been used to determine the vertical and horizontal extent of soil contamination. Investigation results are presented in Table 2. In identifying these contaminants, it was assumed that soil at depths greater than 10 feet would not be available for exposure; therefore, only soils collected from 10 feet or shallower were included in the analysis of investigation results. The contaminants presented in Table 2 are those that were positively detected in at least one sample and were found to be present in concentrations greater than naturally occurring background concentrations. For reference, Table 2 includes measures of the average contaminant concentration (to depths of 2 feet and 10 feet) and the frequency at which the contaminant was detected at those depths.The total volume of soil affected by the contaminants as presented in Table 2 is roughly estimated at more than 33,000 cy. As can be seen in Table 2, no contamination was detected in soils at Sites 7, 58, and 59.

In the course of conducting the soil investigations, clearance of UXO was performed to ensure safe access by people collecting chemical samples. Approximately 80 UXO were found, as well as an extensive amount of inert metal debris. The total area cleared was small (less than 100 acres) compared to the entire ADA, but involved the areas most likely to have UXO. Because this clearance included only a small area, the total quantities, locations, and depths of UXO in the ADA are not well defined.

In general, the chemical contaminants in soil at the ADA can be characterized as having relatively low aqueous solubilities and low volatilities. Potential routes for their migration include the following:

Table 2: Summary of Contaminants of Concern in Soil at the ADA

Site	Contaminant of Concern	Background Concentration ppm (a)	To a Depth of 2 Feet: 95% UCL Concentration ppm	To a Depth of 2 Feet: Frequency of Detection	To a Depth of 10 Feet: 95% UCL Concentration ppm	To a Depth of 10 Feet: Frequency of Detection
7	None		NDB		NDB	
8	Lead	8.37	NA		18.7	4 of 4
	Nickel	12.6	NA		15.2	4 of 4
	Zinc	94	NA		3796	2 of 4
13	Aluminum	8604	NDB		7268	15 of 15
	Antimony	3.8	16.1	1 of 5	6.08	1 of 15
	Arsenic	5.24	14.4	5 of 5	7.85	15 of 15
	Copper	58.6	778	3 of 5	297	4 of 15
	Iron	26233	103653	5 of 5	49282	15 of 15
	Lead	8.37	321	5 of 5	98.8	15 of 15
	Manganese	874	774	5 of 5	659	15 of 15
	Mercury	0.056	0.512	4 of 5	0.201	4 of 15
	Nickel	12.6	85.7	2 of 5	40	4 of 15
	Silver	0.038	6.05	5 of 5	1.93	7 of 15
	Zinc	94	26568	5 of 5	9611	15 of 15
	2,6-DNT	NSA	0.831	1 of 5	0.429	1 of 15
14	Barium	233	311	1 of 2	289	10 of 12
	Chromium (b)	32.7	188	1 of 2	48.7	1 of 12
	Lead	8.37	330	2 of 2	86.2	12 of 12
	Potassium	2179	2320	2 of 2	1867	12 of 12
	Silver	0.038	0.062	1 of 2	0.03	3 of 12
	Zinc	94	1710	2 of 2	459	10 of 12
	Nitrite/Nitrate	9.9	NDB		11.3	10 of 12
15	Antimony	3.8	3396	3 of 4	832	4 of 14
	Arsenic	5.24	20	4 of 4	10.6	14 of 14
	Barium	233	7781	2 of 4	2118	11 of 14
	Beryllium	1.86	12.9	2 of 4	4.98	3 of 14
	Cadmium	3.05	2935	2 of 4	1057	4 of 14
	Chromium (b)	32.7	7160	3 of 4	1937	6 of 14
	Cobalt	15	239	2 of 4	80.2	4 of 14
	Copper	58.6	3120	3 of 4	936	4 of 14
	Iron	26233	130000	4 of 4	63112	14 of 14
	Lead	8.37	695	4 of 4	220	14 of 14
	Magnesium	8585	16199	4 of 4	10369	14 of 14
	Manganese	874	1881	4 of 4	1070	14 of 14
	Mercury	0.056	0.201	1 of 4	0.071	2 of 14
	Nickel	12.6	306	3 of 4	103	4 of 14
	Potassium	2179	3740	4 of 4	2112	14 of 14
	Selenium	0.25	5.57	2 of 4	1.165	3 of 14
	Silver	0.038	2.17	3 of 4	0.772	6 of 14
	Sodium	978	2094	4 of 4	1153	14 of 14
	Thallium	31.3	708	2 of 4	250	3 of 14
	Zinc	94	22813	4 of 4	7229	14 of 14
	1,3,5-TNB	NSA	1.42	1 of 4	0.549	2 of 14
	2,4,6-TNT	NSA	176	1 of 4	48.6	2 of 14
	HMX	NSA	28.6	1 of 4	7.82	3 of 14
	RDX	NSA	126	2 of 4	34.8	8 of 14
	Nitrate/Nitrite	9.1	81	2 of 2	26.9	5 of 10

Table 2: Summary of Contaminants of Concern in Soil at the ADA (continued)

Site	Contaminant of Concern	Background Concentration ppm (a)	To a Depth of 2 Feet 95% UCL Concentration ppm	To a Depth of 2 Feet Frequency of Detection	To a Depth of 10 Feet 95% UCL Concentration ppm	To a Depth of 10 Feet Frequency of Detection
16	Arsenic	5.24	NDB		8.59	45 of 45
	Barium	233	427	5 of 5	257	44 of 45
	Cadmium	3.05	3.31	1 of 5	1.69	1 of 45
	Cobalt	15	19	1 of 5	8.58	1 of 45
	Copper	58.6	118	2 of 5	102	45 of 45
	Silver	0.038	1.49	4 of 5	0.274	26 of 45
	Zinc	94	NDB		542	45 of 45
	Cyanide	0.92	1.14	1 of 5	0.612	4 of 45
	1,3,5-TNB	NSA	NA		0.935	1 of 45
	2,4,6-TNT	NSA	1.07	3 of 5	6.81	6 of 45
	2,4-DNT	NSA	NA		0.232	1 of 45
	HMX	NSA	NA		0.365	1 of 45
	Nitrobenzene	NSA	NA		1.58	1 of 45
	RDX	NSA	1.32	2 of 5	0.949	8 of 45
	Nitrite/nitrate	9.9	15.6	5 of 5	4.31	37 of 45
17	Antimony	3.8	85	2 of 4	NA	
	Beryllium	1.86	3	1 of 4	NA	
	Cadmium	3.05	5.25	1 of 4	NA	
	Cobalt	15	23.7	1 of 4	NA	
	Copper	58.6	299	1 of 4	NA	
	Iron	26233	69158	4 of 4	NA	
	Lead	8.37	1460	4 of 4	NA	
	Nickel	12.6	27	1 of 4	NA	
	Silver	0.038	0.138	3 of 4	NA	
	Sodium	978	948	4 of 4	NA	
	Zinc	94	118	4 of 4	NA	
	2,4,6-TNT	NSA	3.01	1 of 4	NA	
	HMX	NSA	1.69	2 of 4	NA	
	RDX	NSA	12	3 of 4	NA	
18	Aluminum	8604	29945	4 of 4	14059	28 of 28
	Arsenic	5.24	6.19	4 of 4	10.5	28 of 28
	Barium	233	462	4 of 4	1526	28 of 28
	Beryllium	1.86	NA		2.34	3 of 28
	Cadmium	3.05	NA		3.95	4 of 28
	Chromium (b)	32.7	80.6	1 of 4	22.7	6 of 28
	Copper	58.6	100	1 of 4	741	7 of 28
	Iron	26233	NDB		33861	28 of 28
	Lead	8.37	273	4 of 4	266	28 of 30
	Manganese	874	1620	4 of 4	782	28 of 28
	Nickel	12.6	389	1 of 4	63.5	7 of 28
	Silver	0.038	1.68	2 of 4	0.637	17 of 28
	Sodium	978	3073	4 of 4	1544	28 of 28
	Dieldrin	NSA	NA		0.005	1 of 28
	DDE	NSA	NA		0.006	3 of 28
	DDT	NSA	NA		0.01	5 of 28

Table 2: Summary of Contaminants of Concern in Soil at the ADA (continued)

Site	Contaminant of Concern	Background Concentration ppm (a)	To a Depth of 2 Feet 95% UCL Concentration ppm	To a Depth of 2 Feet Frequency of Detection	To a Depth of 10 Feet 95% UCL Concentration ppm	To a Depth of 10 Feet Frequency of Detection
19	Aluminum	8604	25557	4 of 4	8344	44 of 44
	Antimony	3.8	3128	4 of 4	231	4 of 44
	Arsenic	5.24	244	4 of 4	21.6	44 of 44
	Barium	233	25678	4 of 4	2195	44 of 44
	Cadmium	3.05	641	3 of 4	48.7	3 of 44
	Chromium (b)	32.7	43.9	3 of 4	10.7	4 of 44
	Copper	58.6	109139	4 of 4	7908	4 of 44
	Lead	8.37	3908	4 of 4	325	44 of 44
	Mercury	0.056	3.11	2 of 4	0.247	2 of 44
	Nickel	12.6	43.2	3 of 4	11.7	12 of 44
	Potassium	2179	3610	4 of 4	2544	44 of 44
	Silver	0.038	3.4	3 of 4	0.356	10 of 44
	Sodium	978	1160	4 of 4	599	44 of 44
	Zinc	94	211239	4 of 4	15685	40 of 44
	1,3,5-TNB	NSA	143	2 of 4	12	6 of 48
	2,4,6-TNT	NSA	36045	3 of 4	2376	8 of 48
	2,4-DNT	NSA	NA		1.39	1 of 48
	2,6-DNT	NSA	NA		0.87	1 of 48
	HMX	NSA	NA		3.75	4 of 48
	Nitrobenzene	NSA	3.23	1 of 4	7.67	2 of 48
	RDX	NSA	NA		3.5	5 of 48
	Nitrate/nitrite	9.9	11.2	4 of 4	13	18 of 48
21	Lead	8.37	NDB		12	5 of 5
	Nitrate/nitrite	9.9	14.9	4 of 6	8.7	4 of 10
31	Barium	233	315	4 of 4	160	35 of 35
	Copper	58.6	NA		6695	10 of 43
	Iron	26233	55390	4 of 4	23117	35 of 35
	Lead	8.37	39	4 of 4	9.02	41 of 43
	Mercury	0.056	NA		0.066	1 of 43
	Nickel	12.6	NA		22.2	10 of 43
	Silver	0.038	0.461	2 of 4	0.139	8 of 43
	Sodium	978	29731	4 of 4	5180	35 of 35
	Zinc	94	554	4 of 4	138	40 of 43
	1,3,5-TNB	NSA	16	1 of 4	1.66	1 of 35
	2,4,6-TNT	NSA	2180	2 of 4	197	2 of 35
	2,4-DNT	NSA	2.08	1 of 4	0.38	1 of 35
	2,6-DNT	NSA	NA		0.135	1 of 43
	RDX	NSA	3.08	2 of 4	0.548	2 of 35
	Tetryl	NSA	2.07	1 of 4	0.519	1 of 35
	Nitrate/nitrite	9.9	46.2	4 of 4	54	27 of 43
	Trichloroethylene	NSA	NA		0.014	2 of 42
	Xylenes	NSA	NA		0.002	2 of 34
	2-Methylnapthale	NSA	NA		0.155	1 of 35
	Phenanthrene	NSA	0.45	1 of 4	0.153	3 of 43
	Dieldrin	NSA	0.083	1 of 4	1.71	3 of 35
	DDD	NSA	0.083	1 of 4	0.014	2 of 35
	DDE	NSA	0.518	2 of 4	0.051	4 of 35
	DDT	NSA	0.423	1 of 4	0.042	2 of 35
	Endrin	NSA	NA		0.005	1 of 35

Table 2: Summary of Contaminants of Concern in Soil at the ADA (continued)

Site	Contaminant of Concern	Background Concentration ppm (a)	To a Depth of 2 Feet: 95% UCL Concentration ppm	To a Depth of 2 Feet: Frequency of Detection	To a Depth of 10 Feet: 95% UCL Concentration ppm	To a Depth of 10 Feet: Frequency of Detection
32 (Area I)	Copper	58.6	304	1 of 4	NA	
	Lead	8.37	177	4 of 4	NA	
	Potassium	2179	4045	4 of 4	NA	
	Silver	0.038	0.104	4 of 4	NA	
	Zinc	94	1030	4 of 4	NA	
	2,4-DNT	NSA	1.33	3 of 4	NA	
	Nitrate/nitrite	9.9	28	4 of 4	NA	
32 (Area II)	Aluminum	8604	9967	4 of 4	NA	
	Antimony	3.8	30.6	2 of 4	NA	
	Barium	233	23274	4 of 4	NA	
	Copper	58.6	5133	3 of 4	NA	
	Lead	8.37	1263	4 of 4	NA	
	Magnesium	8585	16820	4 of 4	NA	
	Potassium	2179	2487	4 of 4	NA	
	Silver	0.038	631	3 of 4	NA	
	Zinc	94	741	4 of 4	NA	
	2,4-DNT	NSA	1.61	1 of 4	NA	
	Nitrate/nitrite	9.9	26	4 of 4	NA	
38	Copper	58.6	4270	1 of 10	831	3 of 50
	Iron	26233	28363	10 of 10	24518	50 of 60
	Mercury	0.056	0.237	1 of 10	0.065	1 of 50
	Nickel	12.6	20.4	2 of 10	9.64	3 of 50
	Potassium	2179	2207	10 of 10	1818	50 of 50
	Silver	0.038	0.056	5 of 10	0.032	25 of 50
	Zinc	94	2752	10 of 10	965	50 of 50
	Nitrobenzene	NSA	NA		1.31	1 of 50
	2,4,6-TNT	NSA	0.381	1 of 10	2.71	6 of 50
	Tetryl	NSA	NA		0.452	2 of 50
41	Antimony	3.8	8.41	2 of 2	7.31	6 of 10
	Lead	8.37	16.3	2 of 2	11.2	10 of 10
	Zinc	94	99.5	2 of 2	132	10 of 10
55	HMX	NSA	NA		1.03	2 of 12
	RDX	NSA	NA		1.42	4 of 12
56	Beryllium	1.86	2.76	1 of 3	1.85	1 of 6
	Lead	8.37	10.3	3 of 3	7.86	6 of 6
	Magnesium	8585	NDB		8936	6 of 6
57 (Area I)	Lead	8.37	45.6	1 of 1	11.8	17 of 17
	Mercury	0.056	0.137	1 of 1	0.043	1 of 17
	Potassium	2179	2240	1 of 1	1543	17 of 17
	Zinc	94	163	1 of 1	74.5	14 of 17

Table 2: Summary of Contaminants of Concern in Soil at the ADA (continued)

Site	Contaminant of Concern	Background Concentration ppm (a)	To a Depth of 2 Feet: 95% UCL Concentration ppm	To a Depth of 2 Feet: Frequency of Detection	To a Depth of 10 Feet: 95% UCL Concentration ppm	To a Depth of 10 Feet: Frequency of Detection
57 (Area II)	Copper	58.6	127	1 of 3	40.8	1 of 23
	Lead	8.37	170	3 of 3	24.8	23 of 23
	Mercury	0.056	5.1	3 of 3	0.816	3 of 23
	Nickel	12.6	23.5	1 of 3	8.33	1 of 23
	Potassium	2179	2360	3 of 3	1673	23 of 23
	Silver	0.038	0.459	3 of 3	0.069	6 of 23
	Zinc	94	390	3 of 3	105	21 of 23
	Tetryl	NSA	2.02	1 of 3	0.561	1 of 23
57 (Area III)	Cadmium	3.05	5.82	1 of 8	2.31	1 of 40
	Copper	58.6	181	1 of 8	57.1	1 of 40
	Lead	8.37	149	8 of 8	30.9	40 of 40
	Mercury	0.056	0.058	1 of 8	0.031	1 of 40
	Potassium	2179	2073	8 of 8	1415	40 of 40
	Silver	0.038	199	8 of 8	36.4	15 of 40
	Zinc	94	5870	8 of 8	1137	40 of 40
	2,4,6-TNT	NSA	NA		0.268	1 of 40
58	None		NDB		NA	
59	None		NDB		NA	
60	Lead	8.37	11.4	3 of 3	NA	
	Silver	0.038	0.048	3 of 3	NA	

Notes:
ppm - Parts per million
UCL - Upper Confidence Limit
NDB - No samples detected above background
NA - Not analyzed at this depth
NSA - No standard available

(a) - Background concentration as established in Remedial Investigation
(b) - Total chromium

Air
Airborne transport of soil contaminants is the most likely route of contaminant migration at the ADA. This might occur via the dispersion of soil particles by wind or soil disturbances caused by human activity at the contaminated ADA sites. Passive transport of soil contaminants is unlikely given their low volatility.

Surface Water
There is little potential for surface water transport of the contaminants at the ADA. The ADA is not located within a floodplain nor is there run-on or run-off from the ADA. The low precipitation rate and high soil permeability allow for ready percolation of any rain falling directly onto the ADA soil.

Subsurface
Infiltration of precipitation provides a potential subsurface pathway for migration of contaminants in soil at the ADA. However, the rate of transport is expected to be low due to the low precipitation and high evaporation rates in the region. The depth to ground water at the ADA (typically in excess of 60 feet), combined with the low rate of transport of contaminants through the subsurface soils, makes ground water contamination due to the migration of contaminants at the ADA unlikely.

2.5.2 Results of Ground Water Investigation
During the RI, sampling and analysis of ground water was performed at selected sites (or groups of sites) to identify potential ground water contamination beneath the ADA. Investigation results are presented in Table 3. The contaminants presented in Table 3 are those that were positively detected in at least one sample and were found to be present in concentrations greater than naturally occurring background concentrations. For reference, this table includes measures of the average concentration and the frequency at which the contaminants were detected.

Despite the presence of inorganic elements or compounds in the ground water beneath the ADA, there is no evidence that migration of contaminants in soil was, or in the future would be, responsible for ground water contamination. This finding is supported by the general absence of any specific correlation between the contaminants of concern in soil and ground water as well as the lack of evidence that contaminants of concern in ground water have any relation to activities performed at the ADA.

For the most part, contaminants of concern in ground water at the ADA are those that were identified in background ground water characterizations. These inorganics were consistently identified across the entire installation and were not restricted to the ADA.

2.6 Summary of Site Risks

This section summarizes the human health risks and environmental impacts associated with exposure to ADA contaminants, and presents potential remedial action criteria.

2.6.1 Human Health Risks
A human health baseline risk assessment was conducted by the Army to estimate the risk posed to human health by the ADA should it remain in its current state with no remediation. The risk assessment consisted of an exposure assessment, toxicity assessment, and human health risk characterization. The exposure assessment detailed the

Table 3: Summary of Contaminants of Concern in Ground Water at the ADA

Site	Contaminant of Concern	Background Concentration ug/l (a)	95% UCL Concentration ug/l	Frequency of Detection
8 and 31	Antimony	1	2.75	3 of 9
	Arsenic	1	27	10 of 10
	Barium	59	82.8	8 of 8
	Copper	1	4.78	2 of 10
	Vanadium	NSA	96.2	8 of 8
	Zinc	40	389	1 of 9
	RDX	NSA	0.76	1 of 10
	Benzene	NSA	0.417	1 of 10
	Nitrite/nitrate	54000	18996	8 of 10
13 and 57II	Antimony	1	5.71	1 of 4
	Arsenic	1	30.5	4 of 4
	Barium	59	118	4 of 4
	Selenium	1	3.99	1 of 4
	Vanadium	NSA	36.6	4 of 4
14 and 38	Antimony	1	2.72	1 of 4
	Arsenic	1	32.8	4 of 4
	Barium	59	104	4 of 4
	Chromium	1	13.8	4 of 4
	Selenium	1	11.2	4 of 4
	Vanadium	NSA	43.8	4 of 4
15 and 55	Antimony	1	3.13	1 of 2
	Arsenic	1	17	2 of 2
	Barium	59	104	2 of 2
	Manganese	140	238	2 of 2
	Zinc	40	71.2	1 of 2
16	Arsenic	1	26.8	6 of 6
	Barium	59	71.5	6 of 6
	Chromium	1	8.58	3 of 6
	Selenium	1	4	6 of 6
	Vanadium	NSA	141	6 of 6
18	Arsenic	1	40	2 of 2
	Barium	59	147	2 of 2
	Manganese	140	369	2 of 2
	Vanadium	NSA	19.1	2 of 2

Table 3: Summary of Contaminants of Concern in Groundwater at the ADA (continued)

Site	Contaminant of Concern	Background Concentration ug/l (a)	95% UCL Concentration ug/l	Frequency of Detection
19	Antimony	1	18.4	2 of 7
	Arsenic	1	18.2	7 of 7
	Beryllium	NSA	0.5	1 of 7
	Copper	1	3.32	1 of 7
	Lead	5	9.53	1 of 7
	Nickel	NSA	17.7	1 of 7
	Selenium	1	29.8	2 of 7
	Vanadium	NSA	89.5	6 of 6
	1,3- DNB	NSA	0.484	1 of 6
41	Antimony	1	2.34	1 of 7
	Arsenic	1	26.5	7 of 7
	Barium	59	74.2	6 of 6
	Beryllium	NSA	0.5	1 of 7
	Chromium	1	6.09	1 of 7
	Copper	1	6.36	2 of 7
	Lead	5	9.88	3 of 7
	Nickel	NSA	17.7	1 of 7
	Vanadium	NSA	63	6 of 6
	Zinc	40	30	2 of 7
57I	Antimony	1	5.07	2 of 4
	Arsenic	1	30.8	4 of 4
	Barium	59	104	4 of 4
	Chromium	1	13.2	2 of 4
	Copper	1	8.78	1 of 4
	Manganese	140	189	4 of 4
	Vanadium	NSA	37.1	2 of 4
	Zinc	40	40.7	1 of 4
57III	Antimony	1	3.21	3 of 6
	Arsenic	1	27.4	6 of 6
	Barium	59	87.6	6 of 6
	Mercury	0.4	0.449	1 of 6
	Vanadium	NSA	56.8	6 of 6
59	None			

Notes:
UCL - Upper Confidence Limit
NSA - No Standard Available
(a) - Background concentration as established in RI

Ground water was not characterized at Sites 7, 17, 21, 32, 56, 58, and 60 because of the proximity of these sites to others where ground water was characterized exposure pathways (such as dust inhalation) that exist at the ADA for various receptors. The toxicity assessment documented the adverse effects that can be caused in a receptor as a result of exposure to a contaminant.

The health risk evaluation used information on the amounts of contamination identified in the remedial investigation, the toxicity of those contaminants, and possible human exposure to the contaminants. Health risks are defined as those arising from a contaminant's carcinogenic potential or its potential to cause health risks other than cancer. The cancer risk level is the additional chance that an exposed individual will develop cancer over the course of a lifetime. It is expressed as a probability such as 1×10^{-6} (one in a million). Total noncarcinogenic health risks are expressed as a hazard index (HI). In general, an HI of less than or equal to one indicates that even the most sensitive population is not likely to experience adverse health effects. If it is above one, there might be a concern for adverse health effects. The degree of concern typically correlates with the magnitude of the index if it is above one.

Risk assessments involve calculations based on a number of factors, some of which are uncertain. First, the health effects criteria of specific chemicals are often based on limited laboratory studies on animal species that are then extrapolated to humans. Further, the exposure scenario requires estimation of the duration and frequency of exposure, the identity of the exposed individual, and the contaminant concentration at the point of exposure. If the value of the factor required for the risk assessment is uncertain, a conservative estimate is used so that a health-based exposure level or concentration can be calculated. For example, in order to calculate a reference dose for humans, toxicity assessments divide doses observed to cause health effects in animals by an uncertainty factor to account for species differences and human population variability. In the case of uncertainties associated with exposure scenarios, the most conservative plausible scenario is selected. For example, in the ADA risk assessment, risk values for future use exposures were initially calculated for a residential use scenario because it represented the most conservative future use scenario.

Primary databases and models (and their sources) used in the risk assessment to develop toxicity information and health effects assumptions and criteria include:

- Integrated Risk Information System (IRIS) – EPA, 1991
- Health Effects Assessment Summary Tables (HEAST) – EPA, 1991
- Standard Default Exposure Factors – EPA, 1991
- Uptake/Biokinetic (UBK) Model for Lead – EPA, 1991

The use of these databases and models is described in detail in the *Human Health Baseline Risk Assessment.*

Risks of Contaminants of Concern in Soil

Contaminants of concern at the ADA include those contaminants that were found in soil in concentrations above the background concentration determined for that contaminant. Based on this criterion, the following were identified as contaminants of concern at ADA sites:

- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Manganese
- Mercury
- Nickel
- Potassium
- Selenium
- Silver
- Thallium
- Zinc
- Cyanide
- Nitrate/nitrite
- Trichloroethylene
- Xylenes
- 1,3,5-TNB
- 2,4,6-TNT
- 2,4-DNT
- 2,6-DNT
- RDX
- Tetryl
- HMX
- Nitrobenzene
- DDD
- DDE
- DDT
- Dieldrin
- Endrin

The populations at risk of exposure to the contaminants of concern at the ADA were identified by considering both current and future use scenarios. Public access to the ADA is currently restricted, and there is little incentive or opportunity for trespassers to approach the contaminated ADA sites, so public exposure is unlikely. Currently, only installation personnel conducting operations are being exposed to the contaminated ADA sites. Current contaminant exposure routes are correspondingly limited to the inhalation of contaminated soil as airborne dust by these installation personnel (incidental ingestion of contaminated soil is also considered for Site 60 only).

The probability of future human exposures may be high, since reuse of the ADA may be possible. The most likely routes of exposure to contaminants in soil are dermal absorption of chemicals in soil, incidental ingestion of soil, and dust inhalation.

Soil concentrations used in the calculation of risks were Reasonable Maximum Exposure (RME) concentrations. These concentrations are assumed to be the 95 percent upper confidence limit (UCL) on the arithmetic mean of sampling data (values presented in Table 2) unless the UCL is above the maximum detected value in which case the maximum detected value is used. Using these concentrations and exposure factors obtained from EPA's Risk Assessment Guidance for Superfund, chronic daily intake factors for each chemical within each exposure pathway for a given population at risk were calculated.

Using the toxicity and health effects data available and the calculated chronic daily intake factors, excess cancer risks and noncancer HIs were calculated for current and future use scenarios with the assumption that remediation of soils takes place.

Results of the calculations for current land use scenarios are presented in Table 4. As shown, of the current receptors, the highest risks and hazards apply to the open detonation pit and open burning tray workers, whose multiple pathway risk is 8×10^{-7} with a corresponding hazard index of less than one.

Table 4: Summary of Total Risks and Hazard Indices Related to Exposure to Soil for Current Land Use Scenarios

Receptor	Exposure Pathway(s)	Cancer Risk	Hazard Index
Open detonation pit and open burning tray workers	Dust inhalation	8×10^{-7}	<1
Target range users	Dust inhalation and Incidental soil ingestion	1×10^{-9}	<1
Pesticide workers	Dust inhalation	5×10^{-10}	<1

A summary of risks and hazards posed by exposures to contaminated soil associated with the future use of the ADA is presented in Table 5. These risks and hazards were calculated for each of the ADA sites where contamination was present in soil and represent future residential use, the most conservative future use scenario. The exposure pathways used to calculate the values presented in Table 5 are dermal absorption of chemicals in soil (Pathway 1), incidental ingestion of soil (Pathway 2), and dust inhalation (Pathway 3).

As shown, if no soil remediation occurs, the excess cancer risks associated with direct soil contact by future residents assuming a reasonable maximum exposure scenario are greater than 1×10^{-6} for Sites 13, 15, 17, 18, 19, 31, 32, 56, and 57 (Area III). These values are greater than 1×10^{-5} for Sites 13, 15, 17, 18, 19, 31, 32, and 56. Risks for Sites 15, 19, and 31 exceed a level of 1×10^{-4}.

The noncancer hazard indices associated with direct soil contact by future residents assuming a reasonable maximum exposure scenario are greater than one for Sites 15, 16, 17, 19, and 32 (Area II).

The NCP states that the acceptable risk range for carcinogens is 1×10^{-4} to 1×10^{-6} [40 CFR 300.430(e)(2)(i)(A)(2)]. For systemic toxicants (i.e., constituents having a noncancer health effect), the NCP states the following:

> For systemic toxicants, acceptable exposure levels shall represent concentration levels to which human populations, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety. [40 CFR 300.430(e)(2)(i)(A)(1)]

As discussed earlier, acceptable exposure levels are usually evaluated in terms of the HI; an HI of less than or equal to one generally represents an acceptable exposure.

In addition to the cancer and noncancer risk calculation results presented in Table 5, an analysis of risks posed by lead was performed. To determine the potential exposure to lead, an uptake/biokinetic model was used in the Risk Assessment. The level of lead that is determined to present an unacceptable risk to human health is established as a site-specific value based on applicable regulatory guidance including:

- Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites, EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9355.4-02, September 1, 1989
- Supplement to above guidance, OSWER Directive 9355.4-02A, January 26, 1990
- Update on OSWER Soil Lead Cleanup Guidance, August 29, 1991

As a result of the risk assessment and consideration of regulatory guidance, a lead cleanup level of 500 ppm was established at the ADA. This means that sites with lead concentrations in soil of 500 ppm or greater would present an unacceptable threat to human health.

The potential risks associated with exposure to soil contamination by future residents exceed the acceptable carcinogenic risk range, non-carcinogenic hazard level, or action level for lead at the following sites:

Table 5: Summary of Risks and Hazard Indices Related to Exposure to Soil for Future Residential Users

Site	Exposure Pathways	Cancer Risk	Hazard Index
7	(a)		
8	(b)		
13	1,2,3	5×10^{-5}	0.9
14	2,3	8×10^{-7}	0.2
15	1,2,3	4×10^{-4}	200
16	1,2,3	9×10^{-7}	7
17	1,2,3	2×10^{-5}	10
18	2,3	2×10^{-5}	0.6
19	1,2,3	2×10^{-2}	3000
21	2,3	(c)	(d)
31	1,2,3	1×10^{-3}	220
32, Area I	1,2,3	2×10^{-5}	0.08
32, Area II	1,2,3	2×10^{-5}	2
38	1,2,3	2×10^{-7}	0.5
41	2,3	(c)	0.08
55	(b)		
56	2,3	2×10^{-5}	0.002
57, Area I	2,3	(c)	0.005
57, Area II	1,2,3	2×10^{-8}	0.09
57, Area III	2,3	1×10^{-5}	0.3
58	(a)		
59	(a)		
60	2,3	(c)	0.3

Notes:

(a) No contaminants of concern detected

(b) Exposure pathways 1,2, or 3 were not calculated because no contaminants of concern were detected in soils to a depth of two feet. Therefore, no contaminants of concern presented cancer or noncancer risks for these pathways.

(c) Not calculated because contaminant(s) are noncarcinogenic or potency factors are not available

(d) Calculated hazard index less than 1×10^{-3}

Exposure Pathways

1 - Dermal absorption of chemicals in soil

2 - Incidental ingestion of soil

3 - Dust inhalation

- Site 15 (Cancer Risk = 4 x 10^{-4}, HI = 200, 95% UCL lead = 695 ppm)
- Site 16 (HI = 7)
- Site 17 (HI = 10, 95% UCL lead = 1,460 ppm)
- Site 19 (Cancer Risk = 2 x 10^{-2}, HI = 3000, 95% UCL lead = 3,908 ppm)
- Site 31 (Cancer Risk = 1 x 10^{-3}. HI = 220)
- Site 32 (Area II) (HI = 2, 95% UCL lead = 1,263 ppm)

The potential risks associated with exposure to soil contamination by future residents are within or below the acceptable carcinogenic risk range, non-carcinogenic hazard level, and action level for lead at sites 7, 8, 13, 14, 18, 21, 32 (Area I), 38, 41, 55, 56, 57, 58, 69, and 60.

As stated above, the future residential scenario represents the most conservative of the possible future use scenarios. However, future residential use of the ADA is highly unlikely due to the presence of UXO in unknown quantities at unknown depths and locations throughout the ADA. Future industrial use is a far more realistic (and still conservative) future use scenario for the ADA. For this reason, cancer risk and noncancer hazard calculations were performed assuming a future use of light industrial for the sites that exceeded the acceptable residential cancer risk ranges and/or noncancer hazard levels (Sites 15, 16, 17, 19, 31, 32 [Area II]). The results of these calculations are presented in Table 6.

The risks and hazard indices presented in Table 6 indicate that, based on these values, Sites 16, 17, and 32 (Area II) are within or below the acceptable cancer risk range or noncancer level for future light industrial users. However, it should be noted that soils at Sites 17 and 32 (Area II) still exceed the 500 ppm action level for lead.

In summary, in the event of likely future land use changes at the ADA brought about by UMDA's inclusion in the BRAC program, actual or threatened releases of hazardous chemical substances in soil from the site, if not addressed by implementing the response action selected in this ROD, may present a threat to human health associated with future light industrial use at the following sites:

- Site 15
- Site 17
- Site 19
- Site 31
- Site 32 (Area II)

Based on the discussion provided above, if no response action is implemented at the following sites, unacceptable human exposures to hazardous chemical substances in soil will not occur for future light industrial workers:

- Site 7
- Site 8
- Site 13
- Site 14
- Site 16
- Site 21
- Site 32 (Area I)
- Site 38
- Site 41
- Site 55
- Site 57
- Site 58
- Site 59
- Site 60

In addition to the health risks caused by the chemical contaminants in soil, risks are posed by UXOs. UXOs present a human safety hazard if they are encountered and detonate

Table 6: Summary of Risks and Hazard Indices Related to Exposure to Soil for Future Light Industrial Users

Site	Exposure Pathways	Cancer Risk	Hazard Index
15	1,2,3	7×10^{-4}	80
16	1,2,3	6×10^{-7}	1
17	1,2,3	3×10^{-6}	0.9
19	1,2,3	2×10^{-3}	400
31	1,2,3	5×10^{-4}	102
32, Area II	1,2,3	8×10^{-6}	1

Exposure Pathways
1 - Dermal absorption of chemicals in soil
2 - Incidental ingestion of soil
3 - Dust inhalation

accidentally. Accidental detonation could also result in the spread of explosive contamination in the environment.

Risks of Contaminants of Concern in Ground Water

As stated in Section 2.5.2, for the most part, contaminants of concern in ground water are those that were identified in background ground water characterizations. These contaminants were consistently identified across the entire installation and were not restricted to the ADA. The most ubiquitous contaminant of concern in the ground water at the ADA is arsenic, which was detected in levels above the value established in the RI as background (1μg/l) at all sites at which ground water was characterized (with the exception of Site 59).

A summary of risks and hazards posed by exposures to ground water associated with the future use of the ADA is presented in Table 7. These risks and hazards represent future residential use, the most conservative future use scenario. The exposure pathways used to calculate the values presented in Table 7 include one or more of the following:

- Ingestion of Ground Water (Pathway 5)
- Inhalation of Volatile Contaminants Emitted from Ground Water During Showering (Pathway 6)
- Dermal Absorption of Ground Water During Showering (Pathway 7)

As shown in Table 7, ground water-related risks and hazards exceed the future residential use criteria (risk of 1×10^{-6} and HI of 1) at Sites 8, 13, 14, 15, 16, 18, 19, 31, 38, 41, 55, 57I, 57II, and 57III. There are two important points to note about this observation:

- First, all of the exceedences in risk-based values are due to the presence of arsenic in the ground water. However, it is likely that the levels of arsenic measured in ground water at the ADA represent background levels because: the values consistently fall in a range of 10 to 40 μg/l across the ADA (see Table 3); there is no apparent correlation between arsenic levels in ground water and arsenic levels in contaminated soil at the ADA; and, the value established in the RI as background was based on much more limited sampling. Moreover, in no case does arsenic exceed the regulatory maximum contaminant level (MCL) for arsenic of 50 μg/l.

- Second, residential use represents the most conservative of the future use scenarios and a future use of residential for the ADA is extremely unlikely due to the presence of UXO. To evaluate the degree of conservatism represented by a future residential use over the more likely future industrial use for the ADA, the RA included a calculation of carcinogenic risks and noncarcinogenic hazards for both future use scenarios at Site 31. The results of these calculations showed that the risks and hazards for residential users are three times greater than those for industrial users. As with the future residential use scenario, the risks and hazards of exposure to ground water for future industrial users at Site 31 were due to the presence of arsenic.

Based on the discussion above as well as the results of the RI with respect to ground water characterization as presented in Table 3, no remedial action is required for the cleanup of ground water at the ADA.

Table 7: Summary of Risks and Hazard Indices Related to Ground Water Exposure for Future Residential Users

Site	Exposure Pathways	Cancer Risk	Hazard Index
7	None		
8	5,6,7	6×10^{-4}	3
13	5	6×10^{-4}	3
14	5	7×10^{-4}	4
15	5	3×10^{-4}	2
16	5	6×10^{-4}	3
17	None		
18	5	8×10^{-4}	4
19	5	4×10^{-4}	4
21	None		
31	5,6,7	6×10^{-4}	3
32, Area I	None		
32, Area II	None		
38	5	7×10^{-4}	4
41	5	6×10^{-4}	3
55	5	3×10^{-4}	2
56	None		
57, Area I	5	6×10^{-4}	3
57, Area II	5	6×10^{-4}	3
57, Area III	5	6×10^{-4}	3
58	None		
59	None		
60	None		

Notes: Ground water was not characterized at Sites 7, 17, 21, 32, 56, 58, 59 or 60 because of the proximity of these sites to others where ground water was characterized.

Exposure Pathways
5 – Ingestion of Ground Water
6 – Inhalation of Volatile Contaminants Emitted From Ground Water During Showering
7– Dermal Absorption of Ground Water contaminants During Showering

2.6.2 Environmental Evaluation

As part of the Remedial Investigation, an Ecological Assessment (EA) was performed for UMDA. This EA involved a process to evaluate the current and potential effect to site biota from contaminants in soil at UMDA. In this process, the toxicity and environmental fate of contaminants of concern were evaluated on an installation-wide basis for contaminants found at or near the surface. Thirty contaminants of concern were identified at locations at which wildlife might be exposed. These 30 contaminants include metals, explosives and their derivatives, and pesticides. Of these, the most significant in terms of volume, distribution, and relative toxicity, are lead, zinc, aluminum, 2,4,6-TNT, HMX, RDX, and tetryl. These contaminants are found in soils at the ADA.

The chronic toxicities imposed by the contaminants of concern were developed by calculating the ratio of estimated daily contaminant uptake rates to No Observed Adverse Effect Levels (NOAELs) for four indicator species: field mouse, pronghorn antelope, American badger, and Swainson's hawk. Daily contaminant uptake rates are a function of contaminant concentration and exposure pathways. Exposure pathways considered in this assessment include direct or indirect ingestion of soil by the indicator species. The ratio of contaminant uptake rates to NOAELs is represented by a hazard quotient (HQ) for each of the contaminants of concern.

Currently one indicator species, the pronghorn antelope, is excluded from the ADA by a fence. In the event that fence removal occurs in the future, the pronghorn would likely still have no exposure to contaminants in the ADA because it is expected that they will be confined in a new fenced wildlife area at UMDA, moved to another reservation, or harvested.

A summary of the risk characterization performed for the principal contaminants of concern at the ADA is presented in Table 8. As can be seen, contaminants at Sites 15, 19, and 31 present the greatest concern in terms of magnitude of worst-case HQ. In order to determine the variability in individual site HQs, median values of HQ were determined for selected site/contaminant/species combinations as shown. Note that these median values are significantly less than the worst-case values (in fact, often these values were 0 or close to 0) indicating that the worst-case values are not representative of the ADA as a whole.

In summary, sites that represent potentially unacceptable levels of risks to indicator species are also the sites that represent a threat to human health. The implementation of a response action at those sites to the degree necessary to reduce the threat to human health will also reduce the threat to the environment.

2.6.3 Remedial Action Criteria

Neither state nor federal regulations contain chemical-specific soil cleanup standards for the contaminants of concern. However, both authorities provide a framework for developing risk-based remedial action criteria. The State of Oregon requires cleanup to background or, if that is not feasible, the lowest levels that are protective of human health and the environment and feasible. The NCP provides guidelines in terms of acceptable carcinogenic and non-carcinogenic risk.

Potential risk-based remedial action criteria (RAC) were calculated based on direct contact with ADA soils. RAC for the contaminants of concern present at the sites to be subjected to remedial action are presented in Table 9. These RAC represent soil concentrations for future residential and industrial uses equivalent to excess cancer risks of 1×10^{-6} and

Table 8: Environmental Risk Characterization Summary

Indicator Species	Principal Contaminant of Concern	NOAEL (a) (mg/kg/day)	Worst-Case Chronic HQ (Site)	Median HQ	Comments
Field Mouse					Home range for mice is typically smaller than the area of an individual site.
	Lead	0.032	397 (19)	16.2	Lead is the most ubiquitous contaminant of concern at the ADA
	Zinc	9.6	98.5 (19)		
	Barium	1.2	95.8 (19)		
	Antimony	0.35	43.4(15)		
	Cobalt	0.057	18.8(15)		HQ calculated from background soil concentrations suggest a slight health risk from exposure; probable explanation is the inadequacy of the database.
	Cadmium	1.1	9.09(15)	0	Potential neurotoxic and nephrotoxic effects minimal compared to effects of lead
	RDX	1.5	497(15)	0	Acute HQ supports conclusions for chronic HQ
	TNT	10	178(31)	0	Acute HQ supports conclusions for chronic HQ
	TNB	0.11	76.9(31)		Absence of database makes toxicity criteria almost meaningless
Pronghorn					Pronghorns are prevented from entering the ADA due to a high restraining fence.
Badger					Home range for badgers is approximately twice the size of the ADA. Rodents were used as surrogate animals to calculate HQ for Cu, Sb, and Co.
	Copper	0.33	209.0(19)	0.3	Surrogate species may have been unusually sensitive to Cu.
	Barium	0.19	85.8(19)	0	
	Antimony	0.056	38.9(15)		
	Lead	0.067	36.9(19)		
	Zinc	7.4	18.1(19)		
	Cobalt	0.0091	16.6(15)		
	TNT	0.021	195.0(31)	0	
Hawk					Contaminated sites are only about 2 % of the migratory hawk's home range and the sites are probably not preferred hunting grounds for the hawk.
	Lead	0.043	179(19)	4.45	
	Cadmium	0.049	131(15)	0	
	Chromium	0.49	28.6(15)		

Note:
(a) No Adverse Effect Levels – Standardized reference levels that theoretically represent the highest exposure concentration not associated with adverse health effects. The NOAEL is expressed on a basis of milligrams of contaminant per kilogram of body weight per day.

Table 9: Risk-Based Remedial Action Criteria

Contaminant of Concern	CRLs(a) ppm	Background(b) ppm	Risk-Based Remedial Action Criteria: Residential Risk-based (c) ppm	Light Industrial Risk-based (d) ppm	Light Industrial Risk-based (e) ppm
Antimony	3.8	3.8	110	818	818
Arsenic	0.25	5.24	0.363	0.898	8.98
Barium	29.6	233	13700	861	861
Beryllium	1.86	1.86	0.148	0.809	8.09
Cadmium	3.05	3.05	127	2.75	27.5
Chromium	12.7	32.7	19	0.413	3.71
Cobalt	15	15	2.74	20.2	20.2
Lead	6.26	8.37	(f)	(f)	(f)
Mercury	0.05	0.056	81.9	292	292
Nickel	12.6	12.6	470	10.2	102
Selenium	0.25	0.25	1370	10200	10200
Silver	0.025	0.038	1370	10200	10200
Thallium	31.3	31.3	21.9	164	164
Zinc	30.2	94	54800	409000	409000
Nitrate/nitrite	0.6	9.9	438000	NA	NA
Trichloroethylene	0.003	NSA	58	441	4410
Xylenes	0.002	NSA	354000	382000	382000
135 TNB	0.488	NSA	1.05	2.27	2.27
246 TNT	0.456	NSA	1.64	4.24	22.7
24 DNT	0.424	NSA	0.0723	0.187	1.87
26 DNT	0.085	NSA	0.0723	0.187	1.87
HMX	0.666	NSA	1050	2270	2270
RDX	0.587	NSA	5.81	52	520
Nitrobenzene	2.41	NSA	10.5	22.6	22.6
Tetryl	0.731	NSA	211	454	454
DDD	0.008	NSA	2.66	23.8	238
DDE	0.008	NSA	1.88	16.8	168
DDT	0.007	NSA	1.88	12.7	127
Dieldrin	0.006	NSA	0.0399	0.269	2.69
Endrin	0.007	NSA	82.1	613	613

Notes:
NA - Not applicable
NSA - No standard available
(a) Certified Reporting Limit used in RI
(b) Background Concentration established in RI
(c) Based on a Residential cancer risk of 1E-06 or an HQ of 1
(d) Based on a Light Industrial cancer risk of 1E-06 or an HQ of 1
(e) Based on a Light Industrial cancer risk of 1E-05 or an HQ of 1
(f) Cleanup level for lead established at 500 ppm

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1 x 10^{-5}, and/or noncancer risks with HIs of one. For reference and comparison, background concentrations and certified reporting limits for each of the contaminants of concern are also provided.

From the RAC presented in Table 9, cleanup levels were selected. These levels are based on the possible future light industrial use of the ADA with the objective of reducing excess cancer risks to within a range of 1 x 10^{-4} to 1 x 10^{-6} or noncancer risks to one or less (or meeting the action level of 500 ppm for lead). Where these values were at, or very close to, background concentrations or analytical detection limits, they were increased to represent technically feasible criteria while maintaining adequate protectiveness for possible future users of the ADA. At Sites 15, 17, 19, 31, and 32 (Area II), the following contaminants are present at concentrations exceeding cleanup levels:

- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Chromium
- Cobalt
- Lead
- Thallium
- RDX
- 1,3,5-TNB
- 2,4,6-TNT
- 2,4-DNT

The corresponding cleanup levels are presented in Table 10. For reference, this table also shows background and maximum 95 percent UCL concentrations of the contaminants at each of the sites.

The RAC for the ADA also include the removal of UXO to permit safe use of the ADA. Under the current use of the ADA, only a surface clearance of UXO as well as that necessary to safely conduct a cleanup of contaminated soil will be required. However, additional clearance of buried UXO may be required consistent with a future use decided for the ADA (see Section 2.7.7).

2.7 Description of Alternatives

A range of general response actions was considered for remediating the ADA soils. The actions were first screened for general applicability, then several that appeared to be appropriate for the site were evaluated for effectiveness, implementability, and, to a lesser extent, cost. The actions initially evaluated included:

- No action
- Institutional controls (access restrictions, land use restrictions)
- Containment (engineered cap, soil cover, vegetative cover, surface controls)
- On-site disposal
- In situ treatment (biological, physical-chemical, thermal)
- Ex situ treatment (biological, physical-chemical, thermal, off-site treatment/disposal)
- UXO clearance (from the surface and to 1-, 5-, and 20-foot depths)

From this evaluation, five remedial alternatives were assembled that contained one or more elements from the responses listed above. These include:

Table 10: Cleanup Levels for Contaminants at the ADA

Contaminant	Cleanup Level (ppm)	Background Level (ppm)	Concentration in Soil (a) (ppm)				
			Site 15	Site 17	Site 19	Site 31	Site 32-II
Antimony	820	3.8	3396	85	3128	NA	30.6
Arsenic	15	5.24	20	BB	244	BB	BB
Barium	860	233	7781	BB	25678	315	23274
Beryllium	8.1	1.86	12.9	3	NA	NA	NA
Cadmium	28	3.05	2935	5.25	641	NA	NA
Chromium	40	32.7	7160	NA	43.9	BB	NA
Cobalt	25	15	239	23.7	NA	NA	NA
Lead	500	8.37	695	1460	3908	BB	1263
Thallium	160	31.3	708	NA	NA	NA	NA
RDX	52	NSA	126	1.32	3.5	3.08	NA
135-TNB	2.3	NSA	1.42	NA	143	16	NA
246-TNT	23	NSA	176	3.01	36045	2180	NA
24-DNT	1.9	NSA	NA	NA	1.39	2.08	1.61

Notes:
(a)–95% UCL Concentration (shading indicates that concentration is above the cleanup level)
NA–Not Analyzed
BB–Below Background
NSA–No Standard Available
ppm–Parts per million

Alternative 1:	No action
Alternative 2:	Containment of contaminated soil by soil cover
Alternative 3:	On-site treatment of all contaminated soil by solidification/stabilization and on-site disposal
Alternative 4:	On-site treatment of all contaminated soil by both incineration and solidification/stabilization and on-site disposal
Alternative 5:	Off-site treatment of hazardous contaminated soil and off-site disposal

In addition to these alternatives for the cleanup of contaminated soil at the ADA, approaches to quantify and reduce the safety risks due to UXO were examined. These approaches included the detection of UXO and their removal from the ground surface and to depths of 1 foot, 5 feet, and 20 feet. This UXO removal would be performed in conjunction with any one of the cleanup alternatives with the exception of Alternative 1, No Action. A discussion of UXO clearance is provided at the end of this section.

Alternatives 3 and 4 involve the disposal of treated soils and residues in the on-site UMDA landfill. This landfill is located in the eastern portion of UMDA. Under an agreement entered into by the Army and ODEQ, this landfill will cease receipt of municipal waste in mid-1994, but may receive treated soils until late March 1998. The Army is currently in the process of preparing a closure plan for the landfill in accordance with its permit and ODEQ solid waste regulations and guidance.

An additional common element to the alternatives evaluated (with the exception of the No Action alternative) is the requirement for institutional controls at the ADA. Since the requirements for institutional controls are closely tied to UXO clearance, they are also discussed at the end of this section.

2.7.1 Alternative 1: No Action

Evaluation of the No Action alternative is required under CERCLA, serving as a common reference point against which other alternatives can be evaluated.

In Alternative 1, no containment, removal, or treatment of the soil at the ADA would occur, and no new controls would be implemented to prevent human exposure. However, existing security provisions that limit public access will continue until such time as the Army vacates the UMDA facility. Natural recovery of the contaminated soil is unlikely at the ADA due to the characteristics of the dominant contaminants. The contaminants are nonvolatile and therefore their volatilization from soil at ambient temperatures is unlikely. In addition, due to the low organic content of the ADA soils as well as the relative resistance of the contaminants to biodegradation, degradation of the contaminants is unlikely. The primary mechanism that may serve to reduce contaminant concentrations is their dispersion (and resulting dilution) by wind. This mechanism is applicable to surface soils only.

The primary route of migration of contaminants in soil at the ADA is through windblown dust. A course of No Action would do nothing to limit the potential for contaminant migration.

This alternative does not meet the Oregon requirement for cleanup to background, or the lowest levels that are protective and feasible, nor does it achieve protection of human health and the environment within the guidelines of the NCP. The human health risks presented in Table 6 are not reduced.

UXO would remain present at the ADA and would continue to present safety and environmental risks due to the potential for accidental detonation and exposure.

Alternative 1 requires no time to implement and involves no capital or O&M costs.

2.7.2 Alternative 2: Containment of Contaminated Soil by Soil Cover

Alternative 2 involves placing a layer of clean soil over areas of contaminated soil to minimize potential contact with and exposures to contaminated soil while preventing the spread of contamination as dust. The primary actions involved in implementing this alternative include:

- Clear UXO at the contaminated sites to the degree necessary to safely perform soil containment action (assumes a UXO clearance to a maximum of 5 feet in depth).
- Place soil cover over the contaminated areas. The soil cover consists of an 18-inch layer of clean soil obtained from uncontaminated areas at UMDA.
- Plant vegetation on clean soil cover to restore area and prevent erosion.

Estimates of the cost of implementing this alternative were developed based on an estimate of contaminated soil surface area to be covered of 125,000 square feet. The present worth of the alternative assumes completion of the action within 15 months. The estimated costs of implementing Alternative 2 are:

- Capital Costs: $290,000
- O&M Costs: $10,000
- Present Worth: $300,000

The following major ARAR is cited for Alternative 2:

- Alternative 2 may not comply with state requirements for cleanup. Contaminant concentration levels are not reduced in Alternative 2. The state of Oregon considers the use of caps or covers as measures to supplement cleanups. They may be used as substitutes for cleanup only if it is determined that no other cleanup methods are protective and feasible.

2.7.3 Alternative 3: On-Site Treatment of All Contaminated Soil by Solidification/Stabilization and On-Site Disposal

In this alternative, excavated contaminated soil would be treated by solidification/stabilization. Treated materials would be placed in the on-site UMDA landfill. Primary actions involved in implementing this alternative include:

- Clear UXO at the contaminated sites to allow for safe access to, and excavation of, contaminated soil.
- Excavate contaminated soil.
- Conduct treatability studies of the use of solidification/stabilization.
- Treat contaminated soil by solidification/stabilization.
- Confirm, by testing and analysis, that treatment residuals are nonhazardous.
- Dispose of the treatment residuals in the on-site UMDA landfill.

Solidification/stabilization waste treatment processes involve the mixing of specialized additives or reagents with waste materials to reduce (physically or chemically) the solubility or mobility of contaminants in the matrix. A common solidification/stabilization process involves mixing the wastes with a mixture of a pozzolan such as fly ash and cement to produce a relatively high-strength waste/concrete matrix in which contaminants are trapped.

Solidification/stabilization is a commonly used and effective technology to treat soils and sludges contaminated with metals so that the contaminants no longer present any threat to human health or the environment. There is evidence that the technology will also eliminate the potential threat resulting from organic compounds such as explosives and pesticides. Treatability studies are performed to develop the proper mix of chemical additives and operating conditions to achieve the desired results.

The process to be used at the ADA would employ a mobile system brought on site. These systems typically come complete with chemical storage units, chemical feed equipment, mixing equipment (usually a pug mill), and waste and product handling equipment. Implementation of the process would require sufficient land area around the operation to maintain a buffer zone, access roads capable of supporting heavy equipment (in this case, 80,000-lb trailers), and direct and unencumbered accessibility to the waste feed material.

As the contaminated soil is treated, it is discharged to a dump truck, roll-off boxes, or other transportable containers for transport to the disposal area.

A representative solidification/stabilization system has a nominal throughput of 350 tons/day (including material to be treated and reagents).

Estimates of the cost of implementing this alternative were developed based on an estimate of contaminated soil volume of 14,000 cy. The present worth of the alternative assumes completion within 15 months. The estimated costs of implementing Alternative 3 are:

- Capital Costs: $1,100,000
- O&M Costs: $1,300,000
- Present Worth: $2,400,000

The following major ARARs are cited for this alternative:

- This alternative complies with the state of Oregon cleanup requirements. Although cleanup to background is not achieved, the feasibility of cleanup to background was evaluated and considered not cost effective. This alternative provides for the required level of risk reduction to meet industrial future use standards at the ADA.

- This alternative complies with RCRA requirements regarding the identification and listing of hazardous waste (40 CFR 261.3); standards applicable to generators of hazardous wastes (40 CFR 262); land disposal restrictions (40 CFR 268); design and operating standards for treatment units (40 CFR 264); and closure requirements for interim status units (40 CFR 265 Subpart G).

- This alternative complies with state of Oregon Air Pollution Control Regulations that require control of emission involved in the excavation and handling of contaminated soil.

2.7.4 Alternative 4: On-Site Treatment of All Contaminated Soil by Both Incineration and Solidification/Stabilization and On-Site Disposal

This alternative is similar to Alternative 3, except that soils contaminated with organic compounds are treated in a mobile incinerator brought on site rather than by solidification/stabilization. This would result in the destruction of the organic contaminants. The ash resulting from the incineration of these soils would contain most of the metals contained in the incinerated soils. This ash would be combined with the soils containing metals only and treated by solidification/stabilization as described in Alternative 3. The treated soils (and ashes) would be disposed of on site in the UMDA landfill.

Primary actions involved in implementing this alternative include:

- Clear UXO at the contaminated sites to allow for safe access to, and excavation of, contaminated soil.
- Excavate contaminated soil.
- Mobilize incinerator on site.
- Conduct trial burns.
- Incinerate organic-contaminated soil.
- Conduct treatability studies of the use of solidification/stabilization.
- Treat contaminated soil and incinerator residues by solidification/stabilization.
- Confirm, by testing and analysis, that treatment residuals are nonhazardous.
- Dispose of the treatment residuals in the on-site UMDA landfill.

Rotary kiln incineration has been proven in similar remediations to reduce concentrations of explosives in soil to below detection limits. As a contaminant destruction technology for organics, it is protective of human health. Metal contaminants are not destroyed but are contained in fly ash or the treated soil (ash). Solidification/stabilization would be used to treat the metal-containing incineration residues as well as to treat those soils that contain metals contaminants only.

Mobile, or transportable, incineration systems are available in a range of sizes with varying feed rates. In this analysis, it is assumed that a rotary kiln incinerator designed to process 4 tons of material per hour will be used. A treatment area would be developed in close proximity to the ADA, with concrete and asphalt pads for the incinerator and feed staging operations. A trial burn would be conducted to verify the destruction and removal efficiency for the organic compounds and demonstrate performance of the air emission controls.

Estimates of the cost of implementing this alternative were developed based on an estimate of contaminated soil volume of 14,000 cy. The present worth of the alternative assumes completion of the action within 20 months. The estimated costs of implementing Alternative 4 are:

- Capital Costs: $3,400,000
- O&M Costs: $4,100,000
- Present Worth: $6,900,000

The following major ARARs are cited for this alternative:

- This alternative complies with the state of Oregon cleanup requirements. Although cleanup to background is not achieved, the feasibility of cleanup to background was evaluated and considered not cost effective. This alternative provides for the required level of risk reduction to meet industrial future use standards at the ADA.

- This alternative complies with RCRA requirements regarding the identification and listing of hazardous waste (40 CFR 261.3); standards applicable to generators of hazardous wastes (40 CFR 262); land disposal restrictions (40 CFR 268); design and operating standards for treatment units (40 CFR 264); operating requirements and performance standards for hazardous waste incinerators (40 CFR 264, Subpart O); and closure requirements for interim status units (40 CFR 265 Subpart G).

- This alternative complies with state of Oregon Air Pollution Control Regulations that require control of emission involved in the excavation, handling, and incineration of contaminated soil.

2.7.5 Alternative 5: Off-Site Treatment of Hazardous Contaminated Soil and Off-Site Disposal

This alternative involves the excavation and removal of all contaminated soil. As the soil is excavated, it will be analyzed to determine whether its contamination levels are high enough to be considered hazardous according to the RCRA. These soils will be transported off site to a permitted treatment facility to be treated by solidification/ stabilization. Treated soils will then be disposed of in an off-site landfill. Contaminated soils that do not require treatment according to RCRA will be disposed of off site.

Primary actions involved in implementing this alternative include:

- Clear UXO at the contaminated sites to allow for safe access to, and excavation of, contaminated soil.
- Excavate contaminated soil.
- Analyze excavated soil to determine its hazardous characteristics in accordance with RCRA.
- Segregate hazardous and nonhazardous contaminated soil.
- Prepare manifests for the transport of the hazardous contaminated soil.
- Transport hazardous and nonhazardous soil to a RCRA-permitted facility for the treatment of hazardous soil.
- Dispose of treated soil and nonhazardous soil in an off-site landfill.

In this alternative, existing data and additional confirmation sampling and analysis will be used to determine the hazardous characteristics of the soil (with respect to the presence of toxic concentrations of metals, explosives, or pesticides) and allow for segregation of the RCRA hazardous and nonhazardous soil. To the maximum extent possible, segregation will occur during excavation with necessary confirmation analyses performed after excavation.

On-site requirements for the implementation of this alternative are minimal. Personnel will be required to excavate the soil; conduct sampling and analysis of the soil samples; prepare manifests as necessary; and load the excavated soil for transport off site.

Estimates of the cost of implementing this alternative were developed based on an estimate of contaminated soil volume of 14,000 cy. The present worth of the alternatives assumes completion of the action within 12 months. The estimated costs of implementing Alternative 5 are:

- Capital Costs: $3,200,000
- O&M Costs: $0
- Present Worth: $3,200,000

The following major ARARs are cited for this alternative:

- This alternative complies with the state of Oregon cleanup requirements. Although cleanup to background is not achieved, the feasibility of cleanup to background was evaluated and considered not cost effective. This alternative provides for the required level of risk reduction to meet industrial future use standards at the ADA.

- This alternative complies with RCRA requirements for hazardous waste identification and analysis (40 CFR 261.3); standards applicable to generators of hazardous wastes (40 CFR 262); closure requirements for interim status units (40 CFR 265, Subpart G); requirements applicable to treatment of hazardous wastes by off-site facilities that meet RCRA Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF) (40 CFR 264); and land disposal restrictions (LDR) (40 CFR 268). The applicability of LDR will be determined by analyses to determine the hazardous characteristics of the soil with respect to the presence of toxic or reactive concentrations of metals, explosives, and/or pesticides.

- This alternative complies with state of Oregon Air Pollution Control Regulations that require control of emission involved in the excavation and handling of contaminated soil.

2.7.6 Institutional Controls

Implementation of each of the above alternatives for the cleanup of contaminated soil would require that institutional controls be placed upon the ADA because of the presence of UXO. The cost and scope of these controls will depend on the amount of site wide UXO clearance performed after the soil cleanup. In the absence of any site wide UXO clearance, maintaining controls equal to current Army security would be required. These controls include restricted access, fence maintenance, and security surveillance. The present worth cost of permanently maintaining these existing controls is estimated at $1,000,000.

2.7.7 UXO Clearance

For any future use of the ADA that is different from the current use, some degree of UXO removal, or clearance, will be required. The level of clearance required will be specifically dependent on the future use decided upon for the ADA. For this reason, approaches based on different levels of clearance were evaluated. These approaches include:

- Removal of UXO from the ground surface (surface clearance)
- Detection and clearance of UXO to a depth of 1 foot (subsurface clearance)
- Detection and clearance of UXO to a depth of 5 feet (subsurface clearance)
- Detection and clearance of UXO to a depth of 20 feet (subsurface clearance)

At any level of UXO clearance operations, clearance of visible UXO from the ground surface is required. In typical surface clearance operations, a "sweep team" made up of several personnel walk abreast along established grids. The team members count and remove all metallic items. Explosive items encountered may be marked for later removal by personnel trained in explosive ordnance disposal.

After a surface clearance has been completed, subsurface clearance to depths of up to 5 feet is initiated by a subsurface survey usually conducted with hand-held magnetometers (metal detectors) passed over the surface to detect subsurface items. Metallic items detected at depths of 12 inches or less are often identified by probing and may be removed by hand during the survey. Items at greater depths are typically flagged. Once the survey is complete, the flagged locations are revisited to remove the item by excavation with shovels or, if necessary, a backhoe.

Clearance of UXO to a depth of 20 feet (essentially considered a complete clearance) would involve a combination of survey and excavation of the entire area to be cleared to provide for both UXO detection and removal. Such an excavation would not be feasible across the entire ADA and the costs for extensive clearance to that degree would be prohibitive at over $500,000 per acre or over $900 million for the entire ADA. Although a 20-foot clearance is technically feasible, it is impracticable and is not cost-effective. As a result, this alternative was dropped from further consideration.

The present worth costs of implementing each of the levels of UXO clearance retained in the evaluation are estimated at:

- Surface Clearance: $1,212,000 (completed within 1 year)
- Subsurface Clearance (to 1 foot): $7,225,000 (completed within 1 year)
- Subsurface Clearance (to 5 feet): $13,700,000 (completed within 2 years)

Because of unknowns associated with the future use of the ADA as well as the full extent of contamination of the ADA by UXO, a phased approach to UXO clearance was assessed. Phase I of the clearance consists of the following:

- A metallic object survey will be conducted over the entire ADA to obtain an approximate idea of how much metallic debris would have to be removed to clear the ADA of possible ordnance. The present worth cost of this action is estimated at $1,800,000.

- Concurrently with the survey, a "visual sweep" will be conducted over the entire surface of the ADA to locate and remove objects identifiable as ordnance (surface clearance). The present worth cost of this action is estimated at $1,212,000.

Phase II activities will be dependent on the future reuse selected for the ADA. As part of the base closure process, a screening procedure will be used by the Army to develop plans for reuse of Army installations subject to base closure. As outlined in Interim Guidance "Army Base Closure Screening Process" (dated February 8, 1994), the screening procedure consists of the following steps:

1. All Army installations will be screened with other military departments, DoD agencies and instrumentalities, and the Coast Guard. At the same time, installations will be screened with other Federal departments and agencies to determine any use

for the property. All parties must respond within 30 days with requirements for future use.

2. The department or agency that demonstrates an initial interest in the closing property must submit a firm proposal on the future use of that property. The requesting department or agency must agree to reimburse the Army for the full fair market value of the property and transfer funds within two years of the initial request for the property.

3. If not claimed under Steps One and Two, the property will be offered through the Department of Housing and Urban Development for homeless assistance purposes.

4. Local redevelopment authorities will be advised with respect to the availability of remaining unclaimed property. The redevelopment authority will have one year in which to express interest in writing for use of any buildings or property not claimed.

5. Any remaining surplus property will be screened with state and local governments for public purposes. A public agency will be required to advise of its need for the property within 20 calendar days. The state will be allowed 60 days to comment.

6. Any remaining property will be offered for sale to the general public on a competitive basis.

Upon completion of this screening process and the establishment of a future use for the ADA (that is approved by DoD, the state of Oregon, and the local reuse committee), additional clearance of UXO to a depth that is protective for the final land use will be conducted. This Phase II clearance will be initiated within 15 months after the final land use decision has been reached.

Because the full extent of UXO present at the ADA is unknown now, UXO removal costs could easily vary. Table 11 illustrates the relationship between the possible future land uses and corresponding depths of UXO clearance, estimated costs of clearance, and the degree of institutional controls needed.

When the Phase II clearance of UXO has been completed, appropriate institutional controls will be applied to the ADA to permanently limit the use of, and access to, the ADA consistent with the final use selected for the area and the degree to which UXO are cleared. The present worth cost of permanently maintaining these controls is estimated at $1,000,000.

2.8 Summary of Comparative Analysis of Alternatives

This section provides a summary of the relative performance of each of the remedial alternatives with respect to the nine CERCLA evaluation criteria.

2.8.1 Threshold Criteria

Overall protection of human health and the environment. Alternative 1, the No Action alternative, is not protective of human health and the environment. Alternative 2 will not result in the treatment or removal of any of the contaminated soil; however, this

Table 11: UXO Clearance Levels, Costs, and Access Controls Required

Land Use	Degree of Clearance	Estimated Present Worth Cost of Clearance	Access Controls Required
Current Army Use	Surface Clearance/ Survey (Phase I)	$3,012,000	Deed Restrictions, Security, Fencing
Recreational/ Wildlife	Surface to 1 foot	$1,212,000 to $7,225,000	Deed Restrictions, Security, Fencing
Industrial	1 to 5 feet	$7,225,000 to $13,700,000	Deed Restrictions, Security, and/or Fencing
Residential	5 to 20 feet	$13,700,000 to $900,000,000	Deed Restrictions, Security, and/or Fencing

alternative will reduce the risks associated with potential contacts with the soil and spread of contamination by dust.

Alternatives 3 and 4 provide the best potential for effectively protecting human health and the environment from soil contamination at the ADA. These alternatives result in the removal of all contaminated soil followed by treatment to prevent further threats imposed by the contaminants. Following treatment, the treated soils will be placed in the on-site UMDA landfill that will be properly maintained and monitored to ensure that overall protection is maintained. In these alternatives, all actions associated with the cleanup are conducted on site and therefore preclude any risks associated with off-site transport of contaminated or treated soils.

Alternative 5 involves the treatment of only those soils that are defined as hazardous – contaminants in the other soils would be left untreated. However, the disposal of both treated soil and untreated nonhazardous soil in Alternative 5 would be to a properly maintained and monitored landfill. This alternative involves the transport of contaminated soil off site, which presents potential risks to human health and the environment outside the boundaries of UMDA.

Removal of UXO consistent with the selected land use will provide for a reduction of risks and hazards associated with their presence at the ADA. The continued use of institutional controls will further provide long-term protection of human health and safety with respect to UXO.

Compliance with ARARs. Alternative 1 does not comply with ARARs. Alternatives 3, 4, and 5 comply with all ARARs.

State soil cleanup requirements are met by Alternatives 3, 4, and 5 in that contaminants at the ADA sites are reduced to the lowest levels that are protective and feasible. The state of Oregon requirement to determine the feasibility of cleanup to background was evaluated by estimating costs to clean up all the ADA to standards based on residential land use that most closely match background levels. The cleanup to residential land use standards at the ADA would cost approximately twice as much as cleanup to industrial use standards. Since both cleanups would achieve the required level of risk reduction to meet industrial future use standards at the ADA, the additional cleanup cost to reach residential (or background) standards is not cost-effective.

Contaminant concentrations are not reduced in Alternative 2. The state of Oregon considers the use of caps or covers as measures to supplement cleanups. They may be used as substitutes for cleanup only if it is determined that no other cleanup methods are protective and feasible. As a result, Alternative 2 may not meet state requirements.

Alternatives 3, 4, and 5 will comply with applicable RCRA regulations and standards including those establishing requirements for meeting treatment standards for hazardous wastes, hazardous waste analysis and identification, hazardous waste incineration, standards for generators of hazardous wastes, hazardous waste transport and treatment, and closure of interim status units.

Alternatives 3, 4, and 5 will comply with state and federal ARARs that regulate and control air emissions resulting from remedial actions including soil excavation and treatment.

UXO removed as part of the cleanup (including those UXO found in the soil covered or excavated as part of Alternatives 2 through 5) will be deactivated on site by detonation or open burning in accordance with RCRA requirements and conditions of existing RCRA interim status permit requirements at the ADA. These UXO are considered hazardous wastes because their presence at the ADA is a result of a disposal action and because they may have the characteristic of reactivity.

Two of the sites to be cleaned up at the ADA (Sites 16 and 32) are currently operating under RCRA interim status to allow for the ongoing destruction of ordnance and propellant at UMDA. The cleanup described in this ROD will satisfy the requirements for closure of these sites under RCRA guidelines (40 CFR 265 Subpart G). Typically with RCRA closures, wastes left in place are capped and ground water wells are installed and monitored for thirty years under post-closure care in order to ensure protection of ground water. At Sites 16 and 32, wastes left in place are not considered a threat to ground water. Therefore, remediation under this ROD is more appropriate because risk-based levels will be met and post-closure care (including security and access restrictions) will be provided as part of the remedy.

2.8.2 Primary Balancing Criteria

Long-term effectiveness. Alternative 1 does not provide for any long-term risk reduction and therefore does not demonstrate long-term effectiveness.

Under normal circumstances, soil covers such as those to be implemented in Alternative 2 may be long-term and permanent solutions to the spread of contamination. However, they are considered less long-term and permanent than alternatives that involve treatment of the contaminated soil. The imposition of institutional controls to limit access to and use of the ADA will enhance the long-term effectiveness and permanence of this method of containment.

Alternatives 3 and 4 will result in the treatment of all contaminated soil, which offers long-term effectiveness. This effectiveness is further enhanced by disposing of the treated soil in a properly maintained and monitored landfill.

Alternative 5 results in the treatment of only hazardous soils. Untreated soils will continue to present risks that are only moderately reduced by their disposal in a maintained and monitored landfill.

The removal of UXO (including those UXO found in the soil covered or excavated as part of Alternatives 2 through 5), effectively and permanently reduces the risks associated with their presence.

Reduction in toxicity, mobility, or volume of contaminants through treatment. Alternative 1 does not reduce the toxicity, mobility, or volume of contaminants. . Alternative 2 does not involve the treatment of contaminated soils and therefore does not achieve reductions in toxicity or volume of contaminants through treatment. However, the mobility of contaminants is reduced in Alternative 2 by the addition of a clean soil cover.

Alternatives 3, 4, and 5 will result in varying degrees of reducing the toxicity, mobility, or volume of contaminants through treatment. All of these alternatives result in the immobilization of contaminants (by trapping them in a concrete-like material); however, only Alternatives 3 and 4 will result in the immobilization of all contaminants.

Alternative 4 will result in the destruction of explosive contaminants by incineration, thereby decreasing their toxicity and volume.

The removal and deactivation of UXO will reduce the volume of contaminants present at the ADA.

Short-term effectiveness. Alternative 1 is effective in the near term, since public access to UMDA is currently restricted. Operations associated with Alternative 2 are not expected to increase the risks to the community since no contaminants will be released to the environment. Operations associated with Alternatives 3, 4, and 5 provide the potential for risks to human health and the environment as they involve the removal, handling, treatment, and transport of contaminated soil and treated soil. Risks to the environment as well as workers involved in the various activities of these alternatives will be minimized through the application of proper engineering controls (such as wetting the soil to minimize dust emissions) and the use of personal protective equipment. Alternatives 3 and 4 will present fewer risks to the community than Alternative 5 since no actions are conducted off site.

Safety risks and hazards associated with the removal and deactivation of UXO will be minimized by using trained safety personnel and maintaining adequate distances between clearance operations and other activities.

Alternatives 2 through 5 and UXO clearance could be implemented in one to two years.

Implementability. There are no technical or administrative difficulties likely in implementing Alternative 1 since no actions will be required. Activities involved in carrying out Alternatives 2 through 5, as well as UXO clearance, have been successfully used in other cleanups. Services, materials, and equipment are readily available for their performance. Administrative difficulties are expected to be fewest for Alternative 3. Solidification/stabilization will require treatability studies to develop a chemical additive mixture that will meet treatment requirements. Administrative difficulties are more likely for Alternative 4, which requires a trial burn for incineration, and Alternative 5, which involves the off-site transport of hazardous soils.

Cost. The estimated capital, O&M, and present worth costs for each remedial alternative are as follows:

Alternative	Capital Cost	O&M Cost	Present Worth Cost
1	0	0	0
2	$ 290,000	$ 10,000	$ 300,000
3	$ 1,100,000	$ 1,300,000	$ 2,400,000
4	$ 3,400,000	$ 4,100,000	$ 6,900,000
5	$ 3,200,000	0	$ 3,200,000

Present worth costs to conduct the various levels of UXO clearance evaluated are estimated as:

Level of Clearance	Present Worth Cost
Surface Clearance	$ 1,212,000
Subsurface Clearance (to 1 foot)	$ 7,225,000
Subsurface Clearance (to 5 feet)	$13,700,000

2.8.3 Modifying Criteria

State acceptance. The state of Oregon concurs with the Army and EPA in the selection of Alternative 3 for the cleanup of contaminated soils at the ADA. In addition, the state concurs with the initial conduct of a surface clearance and detection of UXO and the detection and quantification of subsurface UXO across the ADA (Phase I clearance actions), and with the Army's commitment for additional UXO clearance as necessary consistent with the final land use designation for the ADA (Phase II clearance). The State of Oregon Concurrence Letter is provided in attachment B of this ROD.

Public acceptance. Based on the absence of any negative comments from the public, the public supports the selection of Alternative 3 as well as the phased approach to be taken with respect to the removal and quantification of UXO.

2.9 Selected Remedy

The selected remedy to clean up the soil contamination associated with the UMDA is Alternative 3, On-Site Treatment of All Contaminated Soil by Solidification/Stabilization and On-Site Disposal. This alternative was selected because it is protective, feasible, and cost-effective. The specific steps to be employed in this cleanup include:

- Excavation of approximately 14,000 cy of contaminated soil at ADA Sites 15, 17, 19, 31, and 32 (Area II). UXO would be removed from these sites during excavation as necessary to permit safe excavation and access.
- Treatment by a mobile solidification/stabilization system.
- Disposal of treated soil from the solidification/stabilization system into the on-site UMDA landfill.
- Restoration of excavated areas with clean backfill and vegetation.

In addition to the cleanup of contaminated soils, safety and environmental risks due to the presence of UXO will be quantified and reduced in two phases, as described below.

Phase I will consist of the following:

- A metallic object survey will be conducted over the entire ADA to better estimate the quantity of metallic debris that would have to be removed to clear the ADA of possible ordnance (at an estimated cost of $1,800,000).
- Concurrently with the survey, a "visual sweep" will be conducted over the entire surface of the ADA to locate and remove objects identifiable as ordnance (at an estimated cost of $1,212,000).

Phase II activities will be dependent upon the future reuse selected for the ADA. As part of the base closure process, future reuse for the ADA will be decided by DoD, the state of Oregon, and the local community. When a suitable future reuse has been finalized, additional UXO clearance will be conducted to a depth that is protective for the final land use (as shown in Table 11).

Upon completion of Phase II UXO clearance actions, appropriate institutional controls will be applied to the ADA to permanently limit the use of, and access to, the ADA consistent with the final use selected for the area and the degree to which UXO are cleared. Such controls may include deed restrictions, maintenance of existing fencing, and/or security. The present worth cost of permanently maintaining these controls is estimated at $1,000,000.

In summary, Phase I of the UXO removal will be conducted concurrently with the cleanup of contaminated soil. Phase II will be initiated within 15 months after the final land use and disposal decision is made on the ADA.

In order to ensure that this cleanup remedy continues to be protective, a site review will be conducted every five years. This review will include verifying that institutional controls remain in place and that land use of the ADA has not changed. In addition, any land transfer will be subject to CERCLA/SARA Section 120(h) provisions.

2.10 Statutory Determinations

The selected remedy satisfies the following requirements under Section 121 of CERCLA:

- Protect human health and the environment
- Comply with ARARs
- Be cost effective
- Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable
- Satisfy the preference for treatment as a principal element

2.10.1 Protection of Human Health and the Environment

The selected remedy, Alternative 3, will reduce risks posed to future users of the ADA through treatment of excavated soils by stabilization/solidification, followed by on-site disposal of the treated soils in the UMDA landfill, and restoration of excavated areas with clean backfill and vegetation. The clean backfill and vegetation will minimize direct contact with any residual contamination remaining after excavation. Excavation of contaminated soil followed by treatment and disposal of treated soil in a maintained and monitored landfill should achieve the following:

- Health risks associated with exposure to carcinogens in the treated soil and in soil that remains in place will be reduced to within the NCP's acceptable range of 1×10^{-4} to 1×10^{-6} (for an industrial use scenario).
- Noncarcinogenic health risks will be reduced to levels at or below a hazard quotient of one.
- Environmental protection is achieved by reducing contaminant concentrations and providing a clean soil layer to support a vegetative cover.
- Health, safety, and environmental risks are reduced by removing UXO to a depth consistent with the selected final land use, thereby significantly reducing the potential for contact and accidental detonation.

No unacceptable short-term risks or cross-media impacts will be caused by implementation of Alternative 3 or removal and detection of UXO. During remediation, adequate protection will be provided to the community and the environment by controlling dust generated during materials handling operations. In addition, workers will be provided with personal protective equipment and air monitoring during all phases of remediation. Safety risks and hazards associated with the removal and deactivation of UXO will be minimized by using trained safety personnel and maintaining adequate distances between clearance operations and other activities.

2.10.2 Compliance with ARARs

The discussion below addresses compliance of the selected remedy with chemical-specific, location-specific, and action-specific ARARs.

Chemical-specific ARARs. The selected remedy complies with the state of Oregon cleanup requirements as set forth in the Oregon Hazardous Substance Remedial Action Rules. Although cleanup to background is not achieved, the feasibility of cleanup to background was evaluated and considered not cost-effective. This alternative provides the lowest residual contaminant levels feasible and protective for future industrial use of the ADA.

The selected remedy complies with RCRA requirements regarding the identification and listing of hazardous waste (40 CFR 261.3); and land disposal restrictions (40 CFR 268).

Location-specific ARARs. The selected remedy complies with requirements of the Endangered Species Act (40 CFR 502) to ensure that no remedial actions will proceed that will negatively affect endangered or threatened species.

Action-specific ARARs. The selected remedy complies with state of Oregon Air Pollution Control Regulations that require control of emissions involved in the excavation and handling of contaminated soil.

The selected remedy complies with RCRA requirements regarding the design and operating standards for treatment units (40 CFR 264); standards applicable to generators of hazardous wastes (40 CFR 262); and closure requirements for interim status units (40 CFR 265 Subpart G).

2.10.3 Cost-Effectiveness

The selected remedy provides overall effectiveness proportionate to its costs. As part of the evaluation of cost-effectiveness, the state of Oregon requirement to determine the feasibility of cleanup to background was considered. The feasibility of cleanup to background was evaluated by estimating costs to clean up all the ADA to standards based on residential land use that most closely match background levels. In this estimate it was determined that approximately 33,000 cy of soil would require treatment. Costs of implementing Alternative 3 to clean up this volume of soil total $4,800,000. This cost is twice that required to achieve cleanup of chemically contaminated sites to meet industrial future use standards at the ADA. Because it is not reasonably foreseeable that the ADA will be used for future residential use, it has been determined that the additional cleanup cost to reach residential (or background) standards is not cost-effective.

2.10.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The selected remedy is a permanent solution that provides the best balance of tradeoffs among the alternatives. Alternative 1 fails to meet the threshold criteria of overall protection and compliance with ARARs and is thus clearly unacceptable. Although Alternative 2 provides a degree of overall protection, it does not comply with ARARs. Alternatives 3, 4, and 5 meet the threshold criteria. These alternatives are comparable in terms of short-term effectiveness and implementability. These alternatives differ in terms of degree of protectiveness afforded and cost. Alternatives 3 and 4 provide a greater degree of protectiveness than Alternative 5 since they involve the treatment of all contaminated soil excavated from the ADA sites. Alternative 3 is the lowest cost of these three alternatives. Alternative 3 is the least costly of these alternatives, and since it meets all of the criteria of the protective alternatives, its selection as the selected remedy is justified.

The selected remedy meets the statutory requirement to utilize permanent solutions and alternative treatment technologies to the maximum extent practicable.

2.10.5 Preference for Treatment as a Principal Element

The statutory preference for treatment is satisfied by using stabilization/solidification to treat all contaminated soil excavated from the ADA sites.

2.11 Documentation of Significant Changes

The selected remedy was the preferred alternative presented in the Proposed Plan. No changes have been made.

3.0 Responsiveness Summary

The final component of the ROD is the Responsiveness Summary, which serves two purposes. First, it provides the agency decision makers with information about community preferences regarding the remedial alternatives and general concerns about the site. Second, it demonstrates to members of the public how their comments were taken into account as part of the decision-making process.

As part of the installation's community relations program, the UMDA command assembled in 1988 a TRC composed of elected and appointed officials and other interested citizens from the surrounding communities. Quarterly meetings provide an opportunity for UMDA to brief the TRC on installation environmental restoration projects and to solicit input from the TRC. Two TRC meetings were held that included presentations and discussions on the remedial alternatives considered and evaluated as part of the feasibility study for the ADA Operable Unit.

In December 1993, the TRC was expanded to a Restoration Advisory Board (RAB) in accordance with DoD guidance. Two RAB meetings were held during the selection of the proposed cleanup alternative for the ADA.

The Feasibility Study and Proposed Plan for the ADA Operable Unit were made available to the public on February 15, 1994. These documents were made available at the following locations: UMDA Building 32, Hermiston, Oregon; the Hermiston Public Library, Hermiston, Oregon; and the EPA office in Portland, Oregon. Notice of the public comment period, public meeting, and availability of the Proposed Plan was published in the *Hermiston Herald,* the *Tri-City Herald,* and the *East Oregonian* in February 15, 1994. The public comment period ended on March 17, 1994.

A public meeting was held at Armand Larive Junior High School, Hermiston, Oregon, on March 2, 1994, to inform the public of the preferred alternative and to seek public comments. At this meeting, representatives from UMDA, USAEC, EPA, ODEQ, and Arthur D. Little, Inc. presented the proposed remedy. Approximately 10 persons from the public and media attended the meeting. There were no questions asked during the informal question and answer period specific to the Proposed Plan for the ADA.

A formal statement regarding the Proposed Plan for the ADA was made by a member of the Oregon National Guard (ONG). This statement was made to convey a preliminary interest in the future use of the ADA for ONG training purposes. A potential future use of the ADA under consideration by the ONG includes the use of a 2,000 meter by 2,000 meter area for tracked vehicles and maintaining other ADA property as an impact area.

Two written comments were received during the comment period and expressed concern about the incineration of explosives and weapons on site at UMDA. The comments were not addressed to a specific operable unit; however, they appear to relate specifically to the Explosives Washout Plant Operable Unit since the proposed remedy for the cleanup of that site involves the thermal oxidation of explosive contaminants in an afterburner. No aspect of the proposed cleanup for the ADA involves incineration.

Attachment A
Site Investigation and Assessment Documents

The following documents contain the results of the site investigation and assessments of cleanup actions for the ADA. These documents were made available to the public at the information repositories located at UMDA Building 32, Hermiston, Oregon; the Hermiston Public Library, Hermiston, Oregon; and the EPA offices in Portland, Oregon.

Remedial Investigation Report for the Umatilla Depot Activity, Hermiston, Oregon. Prepared by Dames & Moore for the U.S. Army Toxic and Hazardous Materials Agency, 1992.

Human Health Baseline Risk Assessment Umatilla Depot Activity, Hermiston, Oregon. Prepared by Dames & Moore for the U.S. Army Toxic and Hazardous Materials Agency, 1992.

Ecological Assessment (EA) Report, Umatilla Depot Activity, Hermiston, Oregon. Prepared by Dames & Moore for the U.S. Army Toxic and Hazardous Materials Agency, 1993.

Feasibility Study for the Ammunition Demolition Activity Area (Operable Unit 4) at the Umatilla Depot Activity. Prepared by Arthur D. Little, Inc. for the U.S. Army Environmental Center, 1993.

Attachment B
State of Oregon Letter of Concurrence

Oregon

DEPARTMENT OF ENVIRONMENTAL QUALITY

July 26, 1994

Mr. Chuck Clarke
Regional Administrator, Region 10
U. S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, WA 98101

Re: Umatilla Depot Activity
Ammunition Demolition Activity
Operable Unit
Record of Decision

Dear Mr. Clarke:

The Oregon Department of Environmental Quality (DEQ) has reviewed the final Record of Decision, for the Ammunition Demolition Activity (ADA) Area Operable Unit at the U.S. Army's Umatilla Depot Activity (UMDA). I am pleased to advise you that DEQ concurs with the remedy recommended by EPA and the Army. The major components of that remedy include:

- Excavation of contaminated soil from Sites number 15, 17, 19, 31, and 32 (approximately 14,000 cubic yards of soil). Unexploded ordnance (UXO) would be removed from these sites as necessary to allow safe access and soil excavation;

- Treatment of contaminated soil by solidification/stabilization to produce a cement-like soil mixture;

- Disposal of the treated soil in the UMDA Active Landfill; and,

- Replacement of excavated soils with clean soil and revegetation of the area.

In addition, a phased approach will be taken to locate and remove UXO from the entire ADA area to a level that is consistent with the future land use selected for the ADA area. Following those actions, institutional controls will be applied to permanently control access to and use of the ADA area, consistent with the final land use selected.

I find that this remedy is protective, and to the maximum extent practicable is cost effective, uses permanent solutions and alternative technologies, is effective and implementable. Accordingly, it satisfies the requirements of ORS 465.315, and OAR 340-122-040 and 090.

811 SW Sixth Avenue
Portland, OR 97204-1390
(503) 229-5696
TDD (503) 229-6993
DEQ-1

Chuck Clarke
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It is understood that placement of any treated wastes from this operable unit into the Depot's Active Landfill is subject to the requirements of the permit for the landfill, previously issued by this Department.

If you have any questions concerning this matter, please contact Bill Dana of DEQ's Waste Management and Cleanup Division at (503) 229-6530.

Sincerely,

Fred Hansen

Fred Hansen
Director

BD:m
SITE\SM5939
cc: Lewis D. Walker, DOD
LTC. Moses Whitehurst, Jr., UMDA
Harry Craig, EPA-OOO
Jeff Rodin, EPA, Seattle
Bill Dana, DEQ/WMCD
Stephanie Hallock, DEQ/ERO